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THE COVER: One 50-ton section of a three-section waterwheel generator stator for Snake River's Idaho Hells Canyon Dam being loaded on flatcar. Story appears on page 756.

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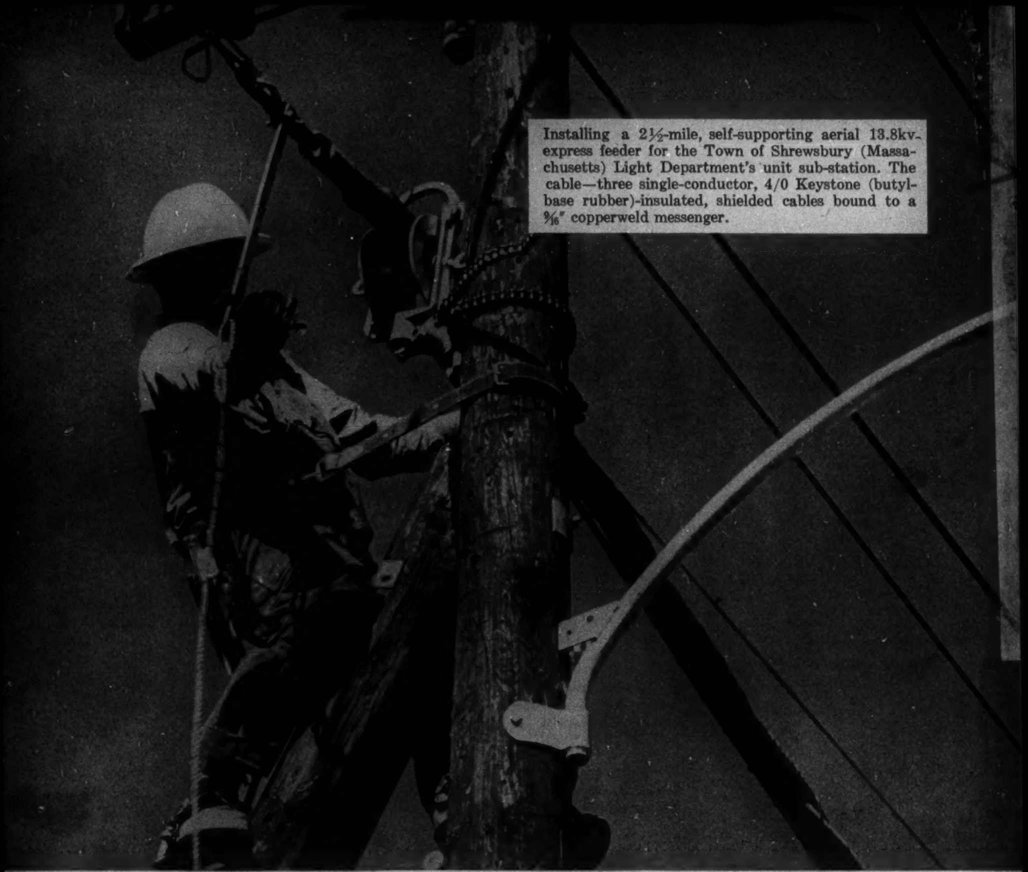

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Recent Developments in Nuclear Instrumentation

R. S. STONE

Some of the newer developments in the field of nuclear instrumentation at General Electric's Knolls Atomic Power Laboratory are discussed. A description is given of typical reactor monitoring and protective instrument systems, as well as the auxiliary instruments for neutron physics experiments.

INSTRUMENTATION in the fields of neutron and reactor physics can be divided into two general categories. The first of these is the general field of reactor instrumentation. Here, there are three basic functions—the monitoring, the control, and the protection of the nuclear reactor. Until these three functions are fulfilled, the reactor cannot be used safely as either a neutron source or a critical assembly.

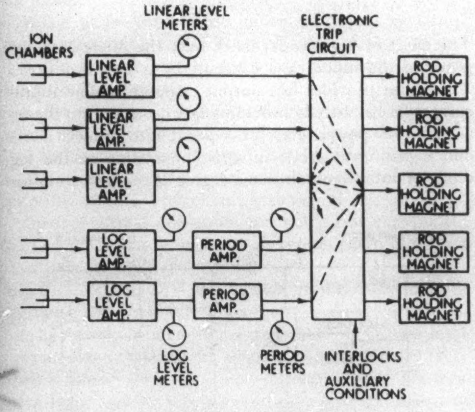

Fig. 1. Reactor protective system.

After the first or operational objective has been satisfactorily reached, the emphasis of the instrumentation program is shifted to an experimental function. Here, the problems consist of collecting and reducing experimental data to obtain physics information relative to a particular reactor system. Information relative to criticality and control range, power or flux distribution, spectral distribution, and dynamic behavior must all be obtained through the use of nucleonic instrumentation.

GENERAL EQUIPMENT ARRANGEMENT

FIRST, the general equipment arrangement used on the critical assemblies and research reactor at the Knolls Atomic Power Laboratory (KAPL) will be discussed. Since these facilities are strictly experimental facilities, the operational philosophy is that when any one instrument gives a scram signal, the reactor is scrammed, even though this signal may arise from equipment malfunction. Fig. 1 is a functional diagram of the system that is used on the critical assemblies and test reactor.

The system consists of five ion chambers which are located in proximity to the reactor. These chambers provide a current signal which is proportional to the reactor power level to five operational amplifiers.

Three of the operational amplifiers are of a zero-stabilized linear type and provide a multirange linear indication of reactor power level. The ranges are scaled in half-decade steps over a total range of six to nine decades. A nonlinear output stage provides a sharply rising voltage when the linear amplifier output voltage exceeds 1.5 times full-scale indication on any range. This signal serves as an input signal to the electronic trip circuit which removes rod magnet holding current when any one of the five input signals exceeds normal level.

The remaining two operational amplifiers consist of units which provide an output that is proportional to the logarithm of the reactor power level and its derivative, the reactor period. The logarithmic output voltage provides wide-range indication of power level on either a meter or recorder, and the period meter provides indication of rate of change of reactor power level. A nonlinear circuit on the output of the period amplifier again provides a sharply rising output voltage if the reactor period becomes unduly short. This increased output voltage removes the holding current for the rod-holding magnets through the electronic trip circuit in the same manner as the signal from the linear amplifiers.

The primary function of the electronic trip circuit is to provide holding current to the rod-holding magnets when all operational conditions have been fulfilled and to remove this holding current from all magnets when any one of the operational conditions is violated. In addition to the five neutron signal conditions previously mentioned, all interlock conditions are fulfilled in this trip circuit.

Essentially full text of a paper presented at the 2nd Nuclear Engineering and Science Conference, Philadelphia, Pa., Mar. 11-14, 1957.

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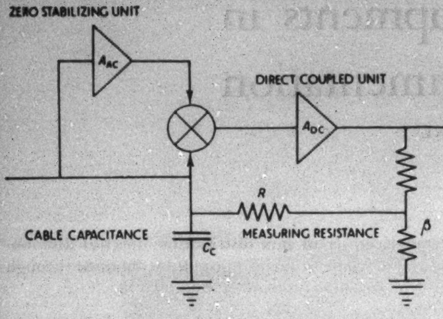


Fig. 2. Zero-stabilizing amplifier.

The over-all system is unique in that the signal path from ion chamber to rod-holding magnet in all cases is a d-c path consisting of amplifiers and passive elements only. This allows monitoring of the d-c levels at specific locations along the signal path to ascertain the present circuit conditions. If these points are within operating limits, then the circuit will function properly when a scram signal occurs on one or more of the input amplifiers.

AMPLIFIERS

A BLOCK DIAGRAM of the zero-stabilized d-c amplifier is shown in Fig. 2. There are two advantages of this arrangement over a simpler circuit in which the voltage drop across a measuring resistance is measured with a high input impedance voltmeter circuit. First, consider the action of the zero-stabilizing unit. This amplifier lacks fast response; however, its input element consists simply of a vibrating capacitance. The change in the contact potential of this element with temperature can be made extremely small, of the order of microvolts per degree. This change in contact potential appears at the output of the amplifier amplified by a factor of $1/\beta$ which at most is equal to 10. With normal temperature variations, this amounts to several millivolts change in output voltage—undetectable on the 10-volt output meter. The contact potential at the input to the direct-coupled unit would appear at the output amplified by a factor of $1/\beta$ without the zero stabilizing unit. Therefore, if there were a 100-millivolt equivalent drift at the input, this would correspond to 10% full-scale deflection of the output meter. With the zero stabilizing unit in the circuit, this drift is attenuated by a factor of A_{ac} or approximately 2,000. This reduces the change in output voltage from the assumed 1 volt to 0.5 millivolts, which again is undetectable on the output meter. The stabilizing unit, therefore, provides an amplifier that has no detectable zero drift.

The second advantage is that by application of negative feedback, the input time constant is degenerated by βA_{dc} for fast transients. In the present amplifiers, a degeneration factor of 2×10^4 is realized. Consider for a moment an input resistor of 10^{11} ohms and a cable capacitance of 1,000 micromicrofarads. Without degeneration, this would yield a 100-second time constant, whereas with degeneration, this time constant is 5 milliseconds. The case without feedback would be completely unacceptable for reactor protection, whereas the feedback case yields a time constant which is shorter than necessary in most cases. This negative feedback, therefore, provides a reactor control instrument that is sufficiently fast on all ranges to protect the reactor adequately.

The trip unit consists of a negatively fed-back loop which maintains a constant output voltage of 40 volts d-c over the full scale range of the instrument. When the amplifier output exceeds 1.5 times full scale, the negative feedback is removed and the trip output voltage rises rapidly to +100 volts. This change in output voltage is applied to the electronic trip circuit as a scram signal.

A functional diagram of the logarithmic and period amplifier[2] unit is shown in Fig. 3.

Consider an input current from a power-level-monitoring ionization chamber. The output voltage of the log amplifier, E_L, is given by V_D/β_L under the assumption that $A_L \gg 1/\beta_L$. At low currents, a diode has a characteristic that $V_D = K \log I$ over a range of six to seven decades in current. Therefore,

$$E_L = \frac{K}{\beta_L} \log I_i$$

The effect of negative feedback over the diode is to degenerate the input time constant by a factor of $A_L\beta_L$. This again provides fast output response at low input-current levels, thereby providing fast protection to the reactor at low power levels. It is possible to connect a second high-current diode in series opposition to the log diode in order to obtain some degree of compensation for contact potential drift due to diode filament-voltage variation.

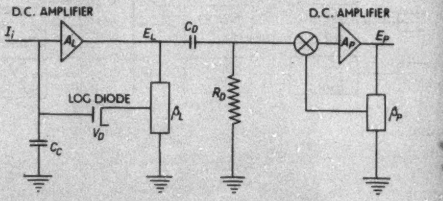


Fig. 3. Logarithmic and period amplifiers.

If it is assumed that the reactor power level is increasing exponentially, then the input current will be of the form

$$I_i\ (t) = I_o \varepsilon^{\frac{t}{\tau}}$$

The voltage at the output of the log amplifier is then

$$E_L = \frac{K}{\beta_L}\left(2.3\frac{t}{\tau} + \log I_o\right)$$

When the voltage is applied to the period amplifier, its output will be

$$E_p = \frac{2.3KBC}{\beta_L\beta_p} \cdot \frac{1}{\tau}\left(1 - \varepsilon^{\frac{-t}{BC}}\right)$$

Asymptotically, this output voltage is then inversely proportional to the reactor period. Thus, it is possible to calibrate a meter in units of reactor period.

The trip-amplifier stage in the log and period amplifier unit consists of a single pentode stage which is normally drawing grid current. The plate voltage is thereby maintained at approximately 40 volts. As the trip period is approached, the grid of this tube is carried negative and the plate potential rises rapidly. This potential rise trips the electronic trip circuit, thereby shutting down the reactor.

TRIP CIRCUIT

The electronic trip circuit[3] in use at KAPL is designed with maximum reactor safety as a basic consideration. The functions of this circuit are as follows:

1. To supply current to each magnet-holding clutch for each safety rod on the reactor.
2. To remove all holding current when any one of the three level inputs or two period inputs calls for reactor scram.
3. To indicate which of the five inputs was responsible for scram.
4. To scram the reactor under conditions of equipment malfunction.
5. To prevent reactor operation unless all interlock conditions are fulfilled.
6. To provide a method of individually dropping safety rods for reactivity calibration experiments.

The basic building block of the electronic trip circuit is the magnet control tube and its associated control amplifier circuit. This circuit is shown in Fig. 4.

During normal operation, the voltage at each of the trip signal inputs is 40 volts; therefore, there is no current flow through the thyrite resistors (τ_1). The control amplifier acts to hold the voltage at the *6CD6* cathode constant, thus maintaining constant magnet current. As one of the trip input voltages rises above its normal level, current flows through the thyrite resistor, and the resistance is sharply decreased. This essentially opens the feedback loop, and the magnet current is now controlled by the trip input signal. As the trip input voltage increases, the input voltage to the control amplifier rises sharply. This results in an increasing bias on the *6CD6* and a sharp reduction in magnet current, thereby releasing the rods.

An individual thyratron circuit associated with each input circuit is activated directly from the input trip signal through a high impedance. This thyratron is biased to fire just prior to the point at which the rod drops. When the thyratron fires, it lights a neon indicator on the front panel to show which of the five inputs was responsible for the scram. Firing one or more thyratrons also energizes a relay which opens a contact in the main interlock circuit. This de-energizes the rod magnet power supply by opening the main contactors, thereby providing a slow backup to the fast scram action of the circuit.

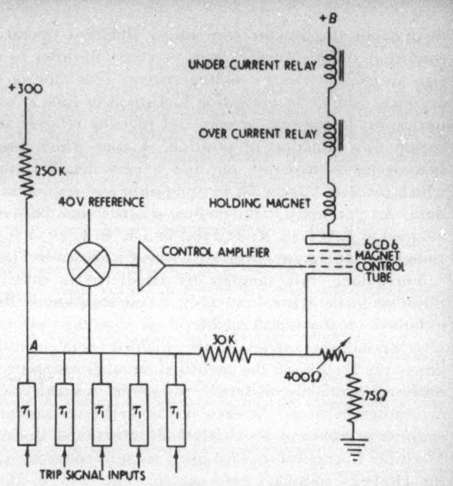


Fig. 4. Magnet control circuit.

CONDITIONS

All auxiliary conditions which must be fulfilled prior to operation are imposed by the main interlock circuit. These conditions are as follows:

1. At least one log- and period-amplifier circuit must be connected into the trip circuit.
2. At least two linear-level instruments must be connected into the trip circuit.
3. All scram switches must be in the circuit.
4. All entrances to the reactor cell must be closed.

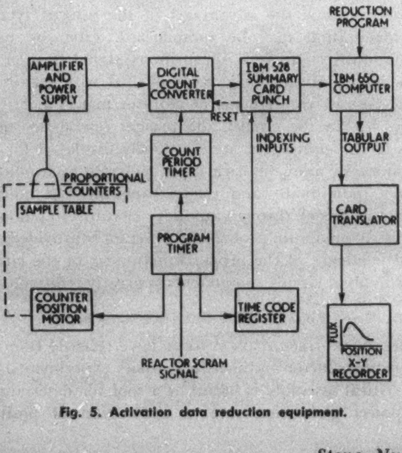
As a conclusion to this discussion on reactor safety instrumentation, the advantages of the present type of instrumentation may be summarized. First, by using vacuum-tube circuits for the primary signal transfer devices, reactor shutdown is accomplished with maximum speed. Second, through use of monitor meters at critical points within the circuit, the present operating conditions of the equipment are constantly displayed for the operators. By allowing each input to scram each holding magnet individually and then letting the first holding magnet feed back through auxiliary circuitry to scram all the rest, a maximum probability of scram is provided and the dependence of the proper functioning of the circuit on individual circuit components is greatly reduced.

TWO RECENT DEVELOPMENTS

Two instrumentation systems have recently been developed for reactor and neutron physics experiments.

A critical assembly is useful as a tool for determining the power generation rate as a function of position throughout the reactor core under different operating conditions. This information is necessary in order to design an efficient reactor-cooling system. This type of experiment is done by activating fuel strips or foils at variout points in the reactor core and plotting relative activation as a function of position. A core which has a heterogeneous structure requires a very detailed study which involves large-scale accumulation and reduction of data. An automatic neutron-flux scanner[4] has been developed at KAPL by R. T. Frost and E. B. Fehr. A functional block diagram of this equipment is shown in Fig. 5.

Three long, thin samples are irradiated in different positions in the critical assembly. These samples are then mounted on the scanner table. A programmed position servomechanism carries three shielded beta counters down the length of the activated samples stopping at uniform increments of length for predetermined count-accumulation times. At each position, the accumulated count is printed out on an IBM (International Business Machines Corporation) card using a count converter and the IBM-*523* summary card punch. The deck of cards generated is then used as an input deck for the IBM-*650* computer. The computing program subtracts the background counting rate, makes corrections for activation time and the decay of activity resulting from the time delay between activation and counting. The output data is then proportional to the neutron flux or power generation rate as a function of position along the activated samples. By activating a number of samples at various points in the core, it is then possible to obtain a complete flux map for the reactor. The output data is available in tabulated form or it can be plotted directly by the use of a Moseley card translator and two-axis recorder.


REDUCTION PROGRAM
AMPLIFIER AND POWER SUPPLY
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IBM 650 COMPUTER
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TABULAR OUTPUT
COUNT PERIOD TIMER
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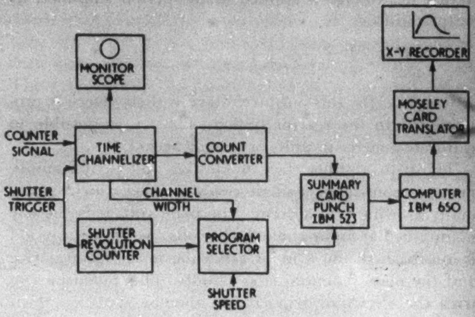
SAMPLE TABLE
CARD TRANSLATOR
PROGRAM TIMER
COUNTER POSITION MOTOR
TIME CODE REGISTER
FLUX
POSITION
X-Y RECORDER
REACTOR SCRAM SIGNAL

Fig. 5. Activation data reduction equipment.


X-Y RECORDER
MONITOR SCOPE
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COUNTER SIGNAL
TIME CHANNELIZER
COUNT CONVERTER
SHUTTER TRIGGER
CHANNEL WIDTH
SUMMARY CARD PUNCH IBM 523
COMPUTER IBM 650
SHUTTER REVOLUTION COUNTER
PROGRAM SELECTOR
SHUTTER SPEED

Fig. 6. Spectrum data reduction equipment.

A second type of experiment that has recently been fully instrumented is the measurement of neutron energy spectra by means of a neutron time of flight spectrometer.[5] A neutron beam is brought out of a reactor or a subcritical assembly excited by a fission source. This beam is chopped into a series of short bursts of neutrons by a rotating shutter. After a given flight path length, the neutrons are detected in a counter. The output counts are sorted as to time of arrival at the counter by a time channelizer. Since the higher-energy neutrons have a larger velocity, they require a shorter time to traverse the distance between the shutter and the counter than does a lower-energy neutron. Therefore, the channelizer gives the velocity distribution of neutrons in the beam. These data can be corrected for counter efficiency, system transmission, and background, and then transformed into an energy spectrum corresponding to the spectrum at the source point within the reactor.

The channelizer is a recent development of D. S. Davidson and E. J. Wade[6] of KAPL. Its magnetic-core memory consists of 256 individual channels each with a count storage capacity of 2^{16} counts. The unique feature of this design is that the circuit is entirely transistorized. The comparable vacuum tube equipment consists of four racks of equipment, whereas the transistorized version occupies a single 10-inch rack panel.

This channelizer is easily adapted to an automatic data processing system as shown in Fig. 6. The channelizer stops accumulating data when any single channel is filled. A readout system is provided in which the stored count in each channel is converted to a series of pulses. These pulses are fed over a coaxial transmission line to a computing facility. Here they are converted to a decimal representation by a count converter whose output goes to an IBM-*523* summary card punch. In addition to the counting information, auxiliary information, including the number of shutter revolutions, the counting channel width, and the run number, is punched on these cards.

The output deck from the summary card punch is fed into the IBM-*650* computer with a prepunched computing program deck which contains the following instructions:

1. Subtraction of background.
2. Correction for the energy dependence of system transmission including counter efficiency and materials in the beam.
3. Calculation of the mean neutron energy associated with each channel.

4. Transformation from a time of flight spectrum to a flux/ev spectrum.

5. Correction relating neutron beam current to neutron flux at the source point.

The output deck from the IBM-*650* computer contains the following information for each channel:

1. The mean energy associated with that channel.
2. The flux per electron volt at this mean energy.
3. The probable error associated with this flux determination.
4. The logarithm of the mean energy.
5. The logarithm of flux per electron volt.
6. The logarithm of the flux plus and minus the probable counting error.

The cards in the output deck may be used to tabulate the output or to feed a card translator which plots the spectrum on log-log paper with plus and minus probable errors.

The saving in man-hours using automatic data reduction methods in cases like the aforementioned two is obvious. The larger dividends in the application of this type of instrumentation comes in freeing the professional person from the routine task of data reduction and in presenting his experimental results in a much shorter time than that required previously.

REFERENCES

1. An Improved D-C Amplifier for Reactor Control, E. J. Wade, R. S. Stone. *Nucleonics*, New York, N. Y., Apr. 1955, pp. 28-30.

2. Log and Period Amplifier, R. S. Stone, E. J. Wade. *KAPL-1236*, General Electric Company, Schenectady, N. Y.

3. An Electronic Trip System for Reactor Protection, E. J. Wade, D. S. Davidson. *KAPL-1528*, General Electric Company, Schenectady, N. Y.

4. Automatic Neutron Flux Scanner, R. T. Frost, E. B. Fehr. *Nucleonics*, New York, N. Y., Mar. 1956, pp. 84-87.

5. Reactor Spectrum Measurements Using a Neutron Time of Flight Spectrometer, R. S. Stone, R. E. Slovacek. *KAPL-1499*, General Electric Company, Schenectady, N. Y.

6. Transistorized Time of Flight Analyzer with Ferrite Core Memory, E. J. Wade, D. S. Davidson. Triparte Instrument Conference, Brookhaven National Laboratory, Upton, N. Y., Oct. 22, 1956.

Information Theory Impact on Modern Communications

PIERRE MERTZ

This is the first of a two-part article on the impact of information theory on the development of communications systems. Some of the specific contributions that have been made are examined, and the nature of their influence on the practical communications art is outlined.

THERE ARE TWO ASPECTS to the development of communications systems, as there are to the development of many other systems. First, there is the invention of the fundamental equipment. The second aspect is the analytical study of the use to be made of this equipment, namely, of the transmission medium between which the equipments are to work, and the engineering of the component parts to give an optimum result.

Much of the design of communications transmission systems has been based on intuitional ideas. This resulted in part from the fact that these systems were based mainly on terminal devices which formed the fundamental basis of the inventions.

In the case of the telegraph, basic equipment was the transmitter or key, and the tape recorder or sounder. Later came the relay. These were connected together with a power source or battery and, at first, just a wire with return to ground between two stations. The thought given to the transmission was for the most part intuitional until Lord Kelvin studied the Atlantic Cable.[1] His contribution, nevertheless, was the siphon recorder, which was a piece of equipment.

In the case of the telephone, a frequency analysis of the signal was sensed early. The basic equipment, the electromagnetic receiver–transmitter (and later the carbon transmitter) necessarily came first. The status of the analysis of line transmission can be surmised when it is recognized that a burning question of the time was whether or not insulators should be used on the open wire lines utilized for the transmission.[2]

The early serious analysis of line transmission became the foundation of information theory. This art, in recent years, has had a rapid mathematical development. So sound, however, had the intuitional optimizing been that much of the impact on the practice has been thus far, to

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Essentially full text of paper 57-635, recommended by the AIEE Committee on Communication Theory and approved by the AIEE Technical Operations Department for presentation at the AIEE Summer General Meeting, Montreal, Que., Canada, June 24-28, 1957. Scheduled for publication in AIEE *Communication and Electronics*, 1957.

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a large degree, a confirmation of the earlier decisions, rather than a generation of new practical engineering designs.

In the literature on this subject there is a large gap between mathematical papers that treat of elaborate methods to refine the selection of a signal received under unfavorable transmission conditions, and descriptive papers that treat of actual communication systems that have been designed to operate with maximum effectiveness by using these methods. This general status is changing, and there is an expectation that information theory will suggest a new art and methods that have actual application to operating systems.

It can be stated that the major contribution of information theory to the communications art has been a mathematical systemization of the broad processes which are involved. This systemization has led to (1) an intensification of the preoccupation with efficiency of transmission; (2) an indication of the methods by which this efficiency may be increased and of the probable price that will have to be paid for this increase, as well as its value; (3) an indication of means that can be used to combat unfavorable transmission conditions, such as excessive noise; and (4) a logical integration of the technical knowledge in the various communications arts, together with indications of possibilities for a better physical integration of the facilities which they use.

CONTRIBUTIONS OF NYQUIST AND HARTLEY

In the course of the transmission of telegraph signals, it was realized that a frequency band was needed for the signal in the transmission medium. A frequent early notion was that it was necessary to transmit the third harmonic of a combination dot and space pattern in order to form the "corners" of the wave adequately.

From 1924 to 1928 Nyquist[3,4] showed that the minimum frequency band needed for the telegraph signal was that required to send a given number of independent quantities per second without ambiguity, and that mathematically the frequency bandwidth in cycles per second was half the number of the independent quantities per second. The "one-half" figure comes from the fact that the Fourier component at a given frequency has two parameters, the amplitude and the phase (the cosine and the sine terms). The "independent quantities" referred to are, in telegraph, mark, or space indications. The choice of only two possible values for each quantity is, however, very restricted. The theory is general enough to apply to the distinction of one of a range of values for each independent quantity.

It was shown by Nyquist that the "characteristic distortion," or "intersymbol interference," or interference between the signal for one independent quantity and that for another, could be reduced to zero by an exact shaping of the electrical transfer characteristic, specified as a function of frequency. He showed that the "independent quantities" could be measured in several ways on the received signal, and that the required shape of transfer characteristic depended upon which way was chosen. Among the several ways or criteria of measuring, one was the amplitude of the signal wave at the exact middle of the signal element duration. Another criterion was the exact spacing between times of transition between various critical amplitudes. Still another criterion was the integrated impulse of the wave amplitude with respect to time during the signal element.

That there is difficulty in cutting off a frequency band sharply to the minimum width which is needed was recognized by Nyquist. He indicated various ways of shaping a "roll-off" about the cut-off frequency without reintroducing the interference between the independent quantities. These roll-offs have again to be shaped differently according to the specific criterion chosen for measuring the independent quantities.

Also, Nyquist indicated that a practical beneficial effect of adding this roll-off was to render more lenient the exactness of line-up of the system while still keeping a low value of intersymbol interference. The roll-off used a somewhat wider band in the frequency spectrum than would a sharp cut-off, and this served as payment for the beneficial effect.

Nyquist's disclosures made it possible to design rationally the frequency bandwidth which was needed to transmit a telegraph signal, or a data transmission signal. These disclosures also gave good grounds for estimating the band that would be required for picture transmission and television signals, although in these cases the ultimate receiver is the eye, which may not follow the rules assumed for the decoding relays or the equivalent—the telegraph or data system.

Paralleling the work of Nyquist were the studies of Hartley[5] and of Küpfmüller.[6] Hartley's contribution are best expressed by his own statement of what has come to be known as "Hartley's law," which is: "The total amount of information which may be transmitted over a system (whose transmission is limited to frequencies lying in a restricted range) is proportional to the product of the frequency-range which it transmits by the time during which it is available for the transmission."

NOISE FILTERING

In the measurement of a physical quantity, small errors are likely to be made. As the quantity varies, and the measurements continue, these erratic errors superpose, in the measurements, on the actual changes in the physical quantity. A complete record of the measurements, therefore, shows a more erratic, or less "smooth," behavior than the actual quantity itself.

This is quite analogous to what is called the "noise" which is superposed on a transmitted signal. The variations of the noisy signal include both the variations of the original signal and the random variations of the noise.

This is often "smoothed," in the case of the data, by using running averages; in the case of electrical signals, by "filtering" them through a low-pass or bandpass filter. There is a danger in such processes in overdoing the smoothing, to the point of suppressing, in part, the actual variations of the physical or original quantity. Or, if the smoothing is insufficient, not as much of the noise is suppressed as could be under the circumstances.

Norbert Wiener[7] between 1942-49 indicated a set of criteria by which an optimum filter could be designed. Essentially, these criteria depend upon an advance knowledge of the correlation among signal amplitudes in successive instants of time, and similarly also a correlation among noise amplitudes. The most effective filter obviously can be obtained where the signal correlation is high (or extends over appreciable time intervals) and the noise correlation low (or extends over only short time intervals.) Basically, this means that the signal frequency band is narrow and the noise band wide. The qualitative conclusion is effectively that which would be obtained from earlier practice. The Wiener contribution, however, gives exact methods for designing an optimum filter. These methods also hold under less clear-cut qualitative circumstances.

This suggestion made by Wiener for the design of an optimum filter has triggered a great wealth of additional suggestions[8-14] and refinements. The objective of the Wiener criterion is to reduce, as far as is possible, the deviation of the actual filter output from what would have been the signal output without noise. This deviation comprises both the change in the signal caused by the filter, and the residual noise itself, after reduction by the filter. The suggestions are often directed toward changing this criterion of optimization. Also, a considerable number of them are aimed at the problem of recovering returned radar signals, either from a great range so that they are immersed in strong noise, or under other extremely unfavorable conditions.

Although these contributions have been great, and are not to be minimized, their primary advances have been of a conceptual nature and few of them have, to the present, been applied to actual communications links. Three conditions have generally conspired to lead to this result. They are:

1. The mathematics for optimizing a filter are complicated and, except for very simple conditions, become prohibitive. The mathematics of Wiener are formidable enough, but in the case of most of the others, they are frequently much worse.
2. The equipment which is required to implement most of these ideas tends easily to become prohibitive in bulk and cost.
3. The advantages which are gained by applying successive refinements to this problem become progressively smaller. A comparatively simple filter, say roughly approximating the Wiener design, in practice, gives a large proportion of the advantage to be expected. Further elaborations are hardly justified in general practical circumstances.

MEASUREMENT OF INFORMATION

THE FIRST STEP negotiated in information theory is really to develop a quantitative notion of what constitutes "information." There are a number of aspects to this concept and several of them are examined here.

According to a first concept (paralleling the ideas of Nyquist and Hartley, but elaborated by Gabor[15,16]), information is that which imparts a representation to a receptor (eventually a person) and that the more complex the pattern of the representation, the more information is required.

In this concept, the representation is structurally separable into distinguishable groups of categories. That is, the representation can be described by a catalog list of items. As an illustration, the representation may be that of a solid figure, say the form of a washer. Here the catalog list is very short, and comprises outside diameter, inside diameter, and thickness. The representation may be more generally that of a polynomial, in which each item represents the coefficient of a given term. Or, the representation may be in other terms, but in each case it appears as a cataloged list of items.

The name "logon" has been given by Gabor to indicate this structural complexity—one "logon" is that which enables one new distinguishable group or category to be added to a representation.

Once the categories of a representation are listed, it is necessary to complete the representation by specifying a quantitative factor for each. This requires a scale. Unit increments along this scale measure the precision of the measurement, on a scale of probable errors (50% of readings for a given quantity within the increment, 50% outside). Such unit increments have been termed "metrons," and the scale termed a "proper scale."

In this concept, the logons are obviously the "independent quantities," of Nyquist. The metrons are simply the quantitative values attached to the independent quantities.

The quantitative notion of information in later years has been generalized in terms of order and disorder concepts. According to this idea, lack of information on an array presumes the possibility of a large number of such arrays from which to choose. This is conceived as a situation of disorder. As information is obtained on the array, the choice from the large number narrows down to a choice from a smaller number, and more order appears. This view becomes analogous to thermodynamic concepts, say of the states of a gas. The quantitative measure of order as against disorder in thermodynamics is the entropy. This (with a negative sign attached, which will not be discussed here) has, therefore, been proposed as a quantitative measure of information by Shannon[17,18] and Szilard.[19] The concept will be considered in somewhat more detail in the next section.

More sophisticated measures of amount of information have been proposed recently in which the criterion is based upon the unexpectedness and importance of the information, or upon concepts obtained from game theory.[20,21] In one of the latter, the measure of the Information is based on possible profits of a gambler betting on the subject matter of the information.

These can be of conceptual interest in developing broad philosophy, and can have impact on communication systems later. They would not have an immediate effect on the design of systems which take any information impartially and send it accurately and impassively to the receiver. They would, however, give a possible clue regarding tolerances on errors in the transmission.

MEASUREMENT IN TERMS OF ENTROPY

In 1948, Shannon[17,18] generalized Nyquist's results into a comprehensive theory. It is, of course, impossible to present anything but a sketchy notion of the drift of these contributions, and the original must be consulted for a more comprehensive view. As has been noted, Shannon defined quantity of information in a fashion analogous to entropy in thermodynamics. Specifically with this approach, the average information H per symbol, or entropy, in a coded sequence is

$$H = -\Sigma_j P_j \log_2 P_j \tag{1}$$

where

P_j = probability of jth configuration or symbol

and where the summation is taken over all possible configurations, and where the probabilities of each of these are independent of the others.

A simple example of such a sequence might be the number 37621. This consists of five successive symbols. Each of these represents some 1 of the 10 configurations of the 10 Arabic numerals. In their general use in numbers like this, the probabilities are independent, are equal, and are each equal to $1/10$. In such a case $H = -10 \times (1/10) \log_2 (1/10) = 3.32$.

When information described by equation 1 is transmitted over a communication channel, some errors will, in general, be experienced. The entropy of the delivered signals is then less than that of the input signals as given by equation 1.

In particular, the signals may be translated into variations of voltage which are impressed upon a circuit. The frequency band of this circuit may be limited to a specific width. The circuit may have superposed noise, that is responsible for the errors which have been assumed. The exact steps of the reasoning cannot be given here, but it turns out that where the noise is suitably random, the entropy of the received impaired signals is equal to the entropy of the unimpaired signals less the entropy of the noise.

$$R = H(s) - H(n) \tag{2}$$

When this is further developed, the maximum transmission capacity (or information per second) of the band-limited noisy channel is

$$R_{\max} = W \log_2 \left(\frac{S}{N} + 1 \right) \tag{3}$$

where

W = frequency bandwidth of channel in cycles per second
S = average power limitation of signal
N = average power of noise

This quantity $R_{\max}$ represents the maximum number of bits per second which can be sent through the channel under the power and frequency bandwidth conditions considered, with a possibility of a vanishingly small percentage of error. This vanishingly small percentage of error assumes an optimum coding, which in general requires merging large groups of symbols of a nonoptimum code, and representing these by large but different groups of the optimum code.

A simple illustration may bring out the significance of this law. Consider a system transmitting two binary digits per second per cycle of frequency band W, which would be a very common system. From the foregoing equation 3

$$\log_2 \left(\frac{S}{N} + 1 \right) \tag{4}$$

$$\frac{S}{N} + 1 = 4 \tag{5}$$

$$\frac{S}{N} = 3 = 5 \text{ db} \tag{6}$$

Actually, in a simple conventional practical system using signal ON for marking and OFF for spacing, noise peaks 6 db down from marking level (or 3 db down from average signal power level) cause errors when of unfavorable polarity. With Gaussian noise, the probability of this is 1 in 10^5 when the peaks are 13 db above rms. Consequently, a signal-to-noise ratio of $13 + 3 = 16$ db, average signal power to average noise power, is needed to maintain an error rate not greater than 1 in 10^5 bits.

Comparison with Shannon's equation shows a penalty of 11 db for not using the optimum code. The first obvious change, of course, would be to a polar rather than a neutral code; i.e., one would use + amplitude for a mark, and − amplitude for a space. This saves 3 db, and still leaves an 8 db penalty.

From this point on, the nature of the preferred codes requires a longer explanation. It can be assumed that the message appears in the conventional binary form, and that it is desired to use it also in this form at the distant end to which the information is to be transmitted. Essentially then, a translation to the preferred code is necessary at the transmitting end of the communication facility, and an inverse translation is necessary at the receiving end. The translator at each end includes such storage as may be necessary to give the required freedom for the construction of the preferred code to be used over the channel path.

It is noted by Shannon that the greatest entropy for the signal is obtained when it has a Gaussian amplitude distribution. Therefore, he suggests for an optimum code that the signal information be grouped into messages containing specific numbers of bits. For each different possible message, a signal is constructed, which has a Gaussian amplitude distribution and, therefore, looks like a sample of random noise. The detection is carried out by comparing the received wave with the constructed signals for all possible messages. That message is selected the signal of which shows the least rms discrepancy from the received wave. As the message lengths are increased, this type of coding and reception can approach a recovery of the 8-db residual disadvantage that was noted previously.

Rice[22] has explored two possible mechanisms for the approximation of such signals with Gaussian distributions. In the one mechanism, the signals are constructed of Fourier polynomials; i.e., finite sums of harmonically related sine and cosine components which, therefore, are uniformly spaced in the allotted frequency interval. The coefficients of the terms are chosen at random from a universe of coefficients that give a fixed average signal power for each constructed signal. In the second mechanism, the signals are constructed of (sin x)/x components. the arguments x are functions of time and the peaks (for $x=0$) are evenly spaced at successive instants of time through the message duration. The components have amplitude coefficients that are chosen at random from a universe of coefficients that gives a fixed average signal power for each constructed signal.

With each of these constructed signals, the ideal rate of signaling (as given by equation 3) is approached, for any arbitrarily small assigned percentage of error, as the message length chosen in forming the code is increased. This means that the 8-db penalty which has been mentioned can be recovered at the expense of storing and translating sufficiently long message groups to bring the error frequency to not more than one in 10^5 bits assumed immediately below equation 6.

The advantage obtained by such codes comes in two steps. First, there is the advantage obtained from the use of a Gaussian distribution of amplitudes, to give the signal a maximum entropy. Second, there is the advantage obtained from a long coding sequence. The exact nature of the latter advantage is somewhat more elusive. Essentially, however, the idea is to take advantage of the exponential growth in number of choices selected by the signal with the number of bits or quantity of information represented in the signal. This exponential is the inverse of the logarithm in equation 1. The number of active choices is the element that remains constant in the transition from one side to the other of the translators. However, by providing a large number of additional and unused choices in the channel side of the translator, redundance can be built into the signal in this location. It is in this location that the major sources of error are found. The ratio of redundant to utilized choices can be made very large for a modest increase in number of bits represented if the coding sequence is long enough, because of the exponential relation between them.

A very simple illustration of this, that does not get into the signal with Gaussian distribution, can start with a group of two binary digits that represents 4 choices. At a 50% increase in speed, three digits in the same time will represent 8 choices. Thus, each of the 4 choices in the original code can be represented by two choices in the speeded-up code.

However, if the original code group is taken as 6 (instead of 2) digits, it represents 64 choices. With a 33⅓% increase in speed (that is, less than the previously considered 50%), 8 digits can be sent in the same time. These represent 256 choices, or a possibility of 4 choices for each of the original code. The freedom to do this increases rapidly as the code group is lengthened.

If the utilized choices are located judiciously among the much larger number of redundant choices, then it has been shown by Shannon,[23] Elias,[24] and others, that errors in the utilized choices will lead most often to "surrounding" redundant choices and only much more rarely to other utilized choices.

The term "surrounding" refers to the possibility, which will not be further detailed here, of plotting all the choices in a multidimensional hyperspace. In this hyperspace plot, choices that are represented by very nearly the same code designations cluster into groups.

A suitable receiver can translate the "surrounding" choices that have been referred to into the "surrounded" utilized choice, which erases the error.

This arrangement can greatly reduce the frequency of occurrence of errors on the system. It requires, of course, some measure of slowing down of the actual rate of useful transmission as evaluated by equation 3. In the limit, as the code groups are taken infinitely long, the amount of slowing down from the ideal rate becomes infinitesimal.

Another type of signal from those of Rice has been suggested by Golay,[25] where the information is carried by the timing of a short duration pulse of larger instantaneous amplitude, but low average power over a given signaling time. The exact instant at which the pulse occurs, over this given time, indicates which one of a finite group of messages is the one transmitted. It appears that the use of this code permits approaching the efficiency indicated by equation 3.

Slepian[26] has studied concrete codes in binary form to obtain the advantages of large groupings. These, of course, do not refer to the band-limited portion of the channel.

Although the elaboration of codes in this manner has proved of great conceptual value, it has not found general favor in practical communications. The basic reasons, as Shannon points out, are that it introduces delay for encoding and decoding. Further, it involves translating and possibly specialized receiving equipment which is bulky and costly, may be uneconomic with the transmission facility, and may introduce additional error hazards. Needless to say, these points are all under careful scrutiny at the present time, and it is not unlikely that in time some derivation of the ideas will find a place in practical utilization.

Perhaps it should be observed that, even more fundamentally, equation 3 really represents an upper limit of performance for idealized limitations only of frequency band and noise. The simple equation is not to be used where it does not apply, or where other derivations are applicable and other limitations are significantly present.

The imperfect equalization of the line, and variations with the time of its net loss, are additional limitations which encroach on the upper limit of performance on a basis of economic equilibrium. Also, the noise is not usually of the idealized type, the frequency band does not cut off sharply, and the timing of sampling instants at the receiver differs from optimum.

These all mean that a performance well under that indicated by the idealized Shannon equation is likely to be in economic equilibrium, and that the value of comparatively elusive highest efficiency codes to actual communications systems is restricted, at least in the present art.

Some work has been done evaluating the influence of imperfect equalization and regulation.[27–31] These both increase the signal-to-noise requirement for a given error performance. A conventional figure for engineering the equalization is to permit the residual error to degrade the noise performance by 3 db. Tolerances on the additional error to be contributed by imperfect regulation vary, but also run in that general order of magnitude.

(The second and concluding article which will appear in the next issue discusses carrier transmission, the "homodyne" detector and the applications of information theory to pictorial transmission, facsimile, television, and telephony.)

REFERENCES

1. On the Theory of the Electric Telegraph (book), W. T. Kelvin. Cambridge University Press, Mathematical and Physical Papers, vol. 2, 1884.

2. Conferences Are an Old Bell System Custom, R. E. Mooney, *Bell Telephone Magazine,* vol. 34, Winter 1955-56, pp. 259-68.

3. Certain Factors Affecting Telegraph Speed, H. Nyquist. *Bell System Technical Journal,* New York, N. Y., vol. 3, April 1924, pp. 324-46.

4. Certain Topics in Telegraph Transmission Theory, H. Nyquist. AIEE *Transactions,* vol. 47, April 1928, pp. 617-644.

5. Transmission of Information, R. V. L. Hartley. *Bell System Technical Journal,* vol. 7, July 1928, pp. 535-63.

6. Transient Phenomena in Wave Filters, K. Küpfmüller. Elektrische Nachrichten-Technik, Berlin, Germany, vol. 1, 1924, pp. 141-52.

7. Extrapolation, Interpolation, and Smoothing of Stationary Time Series (book), N. Wiener. John Wiley & Sons, New York, N. Y., 1949.

8. Optimum Filters for the Detection of Signals in Noise, L. A. Zadeh, J. R. Ragazzini. *Proceedings,* Institute of Radio Engineers, vol. 40, Oct. 1952, pp. 1223-31.

9. An Extension of Wiener's Theory of Prediction, L. A. Zadeh, J. R. Ragazzini. *Journal of Applied Physics,* New York, N. Y., vol. 21, July 1950, pp. 645-55.

10. Information Theory and Inverse Probability in Telecommunication, P. M. Woodward, I. L. Davies. *Proceedings,* Institution of Electrical Engineers, London, England, vol. 99, pt. III, March 1952 pp. 37-44.

11. On Determining the Presence of Signals in Noise, I. L. Davies. *Ibid,* pp. 45-51.

12. Analysis of the Factors which Determine Signal-to-Noise Discrimination in Radar, D. O. North. *Report PTR-6C,* RCA Laboratories, June 1943.

13. An Optimized Theory for Time-Varying Linear Systems with Nonstationary Statistical Inputs, R. C. Booton. *Proceedings,* Institute of Radio Engineers, New York, N. Y., vol. 40, Aug. 1952, pp. 977-81.

14. Statistical Theory of Signal Detection, D. Middleton. *Transactions,* Institute of Radio Engineers, New York, N. Y. PGIT, vol 3, March 1954, pp. 26-51.

15. Theory of Communication, D. Gabor. *Proceedings,* Institution of Electrical Engineers, London, England, pt. III, Nov. 1946, pp. 429-57.

16. The Nomenclature of Information Theory, D. M. MacKay. *Transactions,* Institute of Radio Engineers, New York, N. Y., PGIT, vol. 1. Feb. 1953, pp. 9-21.

17. A Mathematical Theory of Communication, C. E. Shannon. *Bell System Technical Journal,* vol. 27, July 1948, pp. 379-423.

18. A Mathematical Theory of Communication, C. E. Shannon. *Ibid,* Oct. 1948, pp. 623-56.

19. On the Entropy Reduction in a Thermodynamic System by Interventions of Intelligence, L. Szilard. *Zeitschrift fur Physik,* Heidelberg, Germany, vol. 35, 1929, pp. 840-56.

20. Quantal Aspects of Scientific Information, D. M. MacKay. *Transactions,* Institute of Radio Engineers, PGIT-1, Feb. 1953, pp. 60-80.

21. A New Interpretation of Information Rate, J. L. Kelly. *Bell System Technical Journal,* vol. 35, July 1956, pp. 917-26.

22. Communications in the Presence of Noise—Probability of Error for Two Encoding Scheme, S. O. Rice. *Ibid,* Vol. 29, Jan. 1950, pp. 60-93.

23. Communication in the Presence of Noise, C. E. Shannon. *Proceedings,* Institute of Radio Engineers, vol. 37, Jan. 1949, pp. 10-21.

24. Coding for Noisy Channels, P. Elias. *Convention Record,* Institute of Radio Engineers, Pt. IV, March 1955, pp. 37-46.

25. Note on Theoretical Efficiency of Information Reception with PPM, M. J. E. Golay. *Proceedings,* Institute of Radio Engineers, vol 37. Sept. 1949, p. 1031.

26. A Class of Binary Signaling Alphabets, D. Slepian. *Bell System Technical Journal,* vol. 35, Jan. 1956, pp. 203-34.

27. Theoretical Fundamentals of Pulse Transmission, E. D. Sunde. *Ibid,* vol 33, May 1954, pp. 721-88.

28. Theoretical Fundamentals of Pulse Transmission, E. D. Sunde. *Ibid,* July 1954, pp. 987-1010.

29. Effects of Signal Fluctuation on the Detecting of Pulse Signals in Noise, M. Schwartz, *Transactions,* Institute of Radio Engineers, PGIT, vol. 2, June 1956, pp. 66-71.

30. Communication through Noisy, Random, Multipath Channels, G. L. Turin. *Convention Record,* Institute of Radio Engineers, pt. V, March 1956, pp. 154-166.

31. Transmission Line Characteristics and Effects on Pulse Transmission, P. Mertz. *Symposium on Information Networks,* Brooklyn Polytechnic Institute, vol 3, April 1954, pp. 85-114.

Small High-Speed Computer

J. A. Githens and J. A. Baird of Bell Telephone Laboratories check the control panel of Leprechaun, a new high-speed digital computer. Developed under a U. S. Air Force contract, this extremely flexible electronic computer is distinguished by its low power and small size. One of its outstanding features is that it can be used as a test model for research on digital computers designed for military applications. Proposed designs can be laboratory tested without building new equipment by reconnecting Leprechaun's components to simulate the desired apparatus.

An Instrument for Measuring Thermal Neutron Flux

C. V. WEAVER C. K. SMITH J. W. CHASTAIN

AN INSTRUMENT has been developed to measure thermal neutron flux directly and automatically in the range from 10^{13} to 10^{14} neutrons per square centimeter per second at ambient temperatures up to 350 C. When two nearly identical elements, one containing enriched, and the other natural uranium are placed together in a neutron flux, a temperature difference will exist between them caused by fissioning in the fueled element. Since both are heated equally by gamma radiation, this temperature difference can be related to neutron flux. If the element containing natural uranium is heated electrically to the temperature of the fueled element, the electric power required will be proportional to the difference in heat generated between the two elements and to the neutron flux. The system, shown in Fig. 1, functions as follows: When a temperature differential exists because of fissioning in the sensing element, the electric potential in the differential thermocouple actuates a proportioning controller, which regulates the power output of a magnetic amplifier supplying electric heating power to the balancing element. This automatic adjustment of power to the balancing element continues until the temperature difference between the sensing and balancing element is zero. The equivalent of the net fission power is read directly from a wattmeter.

In the thermal neutron flux sensing assembly, the sintered ceramic elements contain 49.18 w/o (% by weight) Al_2O_3, 49.18 w/o $MoSi_2$, 1.64 w/o UO_2. The sensing element contains highly enriched UO_2; the balancing element, natural UO_2. The elements are assembled in a stainless steel case 3/16 inch OD by 2-3/16 inches long.

The original flux-measuring device could measure flux at 37 points along a reactor core in 37 minutes, with a maximum error of 3 to 5%. The newer instruments are capable of making a flux-measuring traverse through a 3-foot fuel assembly in less than 10 minutes. Power measurements can be converted immediately to thermal neutron flux data (1) by directly calibrating the instrument by other flux measuring techniques or (2) by direct calculations from the formula $\theta = kp$, where

θ = thermal neutron flux (neutrons per cm² per second)
p = power supplied to the balancing element
k = a constant which can be calculated from the nuclear and physical properties of the UO_2 in the elements

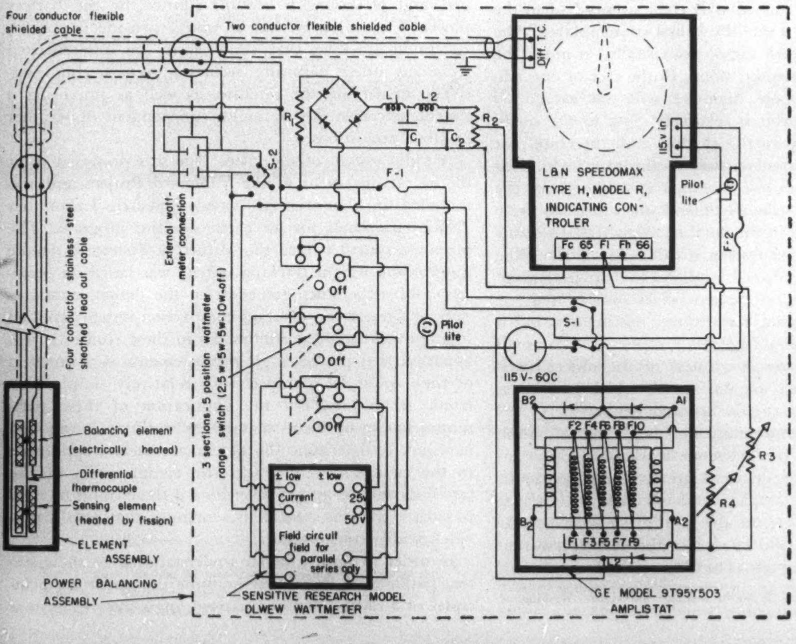
Four conductor flexible shielded cable
Two conductor flexible shielded cable
Diff. T.C.
R1
L1
L2
C1
C2
R2
S-2
F-1
115 v in
L&N SPEEDOMAX TYPE H, MODEL R, INDICATING CONTROLER
Pilot lite
F-2
Fc 65 Fl Fh 66
External wattmeter connection
Four conductor stainless-steel sheathed lead out cable
3 sections-5 position wattmeter range switch (2.5w-5w-5w-10w-off)
Off
Off
Off
Pilot lite
S-1
115 V-60C
B2
A1
F2 F4 F6 F8 F10
R3
R4
B2
A2
F1 F3 F5 F7 F9
L2
Balancing element (electrically heated)
Differential thermocouple
Sensing element (heated by fission)
ELEMENT ASSEMBLY
POWER BALANCING ASSEMBLY
± low
± low
Current
25v
50v
Field circuit field for parallel series only
SENSITIVE RESEARCH MODEL DLWEW WATTMETER
GE MODEL 9T95Y503 AMPLISTAT

Fig. 1. Basic thermal neutron flux measuring system and circuit diagram.

Digest of paper 57-406, "The Development of a Thermal-Neutron-Flux-Measuring Instrument," recommended by the AIEE Committee on Nucleonic and Radiation Instruments and approved by the AIEE Technical Operations Department for presentation at the 2nd Nuclear Science and Engineering Conference, Philadelphia, Pa., Mar. 11-14, 1957. Scheduled for publication in AIEE *Communication and Electronics*, 1957.

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Minitrack System Design Criteria

J. T. MENGEL

The operating principles of the radio phase-comparison angle-tracking system known as Minitrack are examined. Design criteria for the system are discussed with reference to the severe weight and size limitations and altitude limits of the Vanguard satellite.

IN THE ESTABLISHMENT of a satellite in an orbit about the earth, the problems of acquiring it initially by ground instrumentation, and then tracking it with sufficient precision to determine its orbit assume major proportions. These problems can be likened to that of the classical little boy who "shot an arrow into the air . . ." In the case of the Vanguard satellite, it is hoped that the "fall to earth" suffers a substantial time delay.

The Vanguard Project, in addition to its responsibilities for the launching of the earth satellite, is responsible for proving that a satellite has been established in an orbit around the earth. It is this latter responsibility that requires that a method of ground based acquisition and tracking of the satellite be provided.

OPTICAL TRACKING

SEVERAL METHODS immediately come to mind when the problem of tracking a satellite is first contemplated. The first method, is to track the object visually, in much the same manner as we see the moon. In the case of our subminiature moon, whose diameter will not exceed 20 inches, and whose orbit is relatively close to the earth, it will be within the earth's shadow and, therefore, not illuminated for a large portion of the time, while for most of the remainder of the time it will be over the sunlit atmosphere of the earth and, therefore, no more visible than the stars in the daytime. This actually limits the periods of the day during which one can track the object visually by reflected sunlight to two periods of possibly one hour each—one just before sunrise, and one just after sunset. During these times, optical tracking is feasible, but somewhat difficult because of the small size and extremely low brightness of the object, combined with its higher angular speed, which can be as great as 360 times the angular speed of the stars.

When optical instruments are used, this situation changes completely. If a telescope is used, the apparent brightness of the star increases greatly compared to its background, making it quite probable that the satellite will be seen. However, the use of the telescope has decreased the effective field of view of the observer, so that now he needs information as to where to look or, alternatively, many more observers to look with him, each of whom would scan a preassigned sector of the heavens in a manner designed to provide an intercept by the satellite as it passed within seeing range of this location.

A second optical method would be one that increased the visual brightness of the satellite by self-contained lights, or by illumination from the earth. Both of these methods are possible but, either because of the weight of the power source for the self-contained light or because of the extreme power and tracking accuracies required from a ground based searchlight system, there are serious technical drawbacks that detract from their suitability for this program.

RADIO TRACKING

AS AN ALTERNATIVE to optical methods, radio tracking methods are next considered. Because of weight limitation, a passive system using ground based transmitters initially appears to be a plausible solution, until the prohibitive power requirements of a ground transmitter are calculated. For this reason, the use of an active system using a radio transmitter within the satellite was considered. Such a system would have the disadvantages of imposing a weight penalty in the payload of the satellite, and of having a lifetime limited by the battery power it could carry, but it would provide a positive system of tracking that could easily be differentiated from any other naturally occurring signals, thus positively identifying the satellite, as well as providing a system, operable day or night, independent of weather or cloud conditions.

A radio system of the latter type was proposed prior to the establishment of the Vanguard Project and was included in the original Naval Research Laboratory (NRL) proposals for an earth satellite program. The proposed system named the Minitrack System to denote a minimum weight tracking system, was based on previous NRL experience gained from the design, construction, and operation of phase-comparison systems applied to angle-measurement studies. From these studies it was apparent that precise angle measurements as a function of time could be obtained with relatively simple electronic techniques. For the application of these techniques to the problems of satellite tracking, it was first necessary to determine the system parameters applicable to the stringent weight and size requirements of the satellite package, and to determine if these could be used in such a tracking system in a manner that would provide useable tracking data.

In order to form a better understanding of these system parameters, let us first examine the operating principles of a radio phase-comparison angle-tracking system

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such as Minitrack. Such a system operates as radio interferometers, obtaining the angular position of a radio source by measuring the difference in radio path lengths from the source to each of a pair of antennas. For instance, Fig. 1 shows two antennas erected on a baseline A_1A_2, which is precisely measured in length, location, and direction. From the known measured length l_1, of this base line, its radio path length is known to be n wavelengths, or 360 n degrees of radio phase. The signal from radio source S arrives at antenna A_1 at the same time as it arrives at point P. Thus, PA_2 is the difference in radio path length between radio paths SA_1 and SA_2, equal to m wavelengths, or 360 m degrees of radio phase. For S at great distances, A_1PA_2 is a right triangle, and the cosine of angle α is PA_1/d_1, or m/n. Thus, if a measurement of the relative phase of the signals arriving at A_1 and A_2 could be made, the value of m, and hence α would be determined. This is the function of the Minitrack System, which can measure relative phase from a fraction of a degree to 360 degrees. Readings above 360 degrees repeat as though they were referred to zero, thus giving ambiguous readings whenever the path length difference exceeds one wavelength. Such ambiguities are resolved by using multiple pairs of antennas for each baseline direction, arranged so that the shortest baseline does not produce a radio path length difference exceeding one wavelength anywhere within the beam pattern of the antennas used. The outputs of each of these antenna pairs are then used in much the same manner as a coarse and fine synchro system.

Fig. 2 shows how the addition of another baseline, orthogonal to the first, provides a second angle to the radio source. All of the angle measurements are made as direction cosines, so that two such measurements allow the third direction cosine to be calculated, thus completely determining the angular position of the radio source.

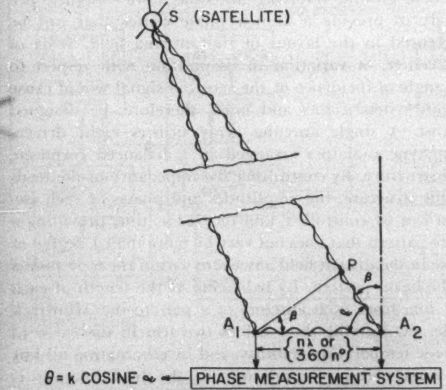

Fig. 1. Basic method of locating the angular position of the satellite by measuring the difference in radio path lengths to each of a pair of antennas.

Let us now consider the problems associated with the satellite itself to see if such a system would be feasible for satellite tracking.

The satellite, for reasons of energy conservation, will be launched in an easterly direction at an orbital inclination now established at between 35 and 40 degrees. Satellite altitudes will generally be above the ionosphere, requiring radio signals to traverse virtually the entire depth of the ionosphere. Payload of the satellite will provide the most serious system-design stumbling block—allowing only an absolute minimum of satellite transmitter weight, requiring the smallest and lightest circuit components, the least amount of battery power, and the greatest possible power conversion efficiency to be utilized.

At the ground, antenna arrays were considered feasible in sizes up to nearly 100 feet, if they could be in the form of arrays that were fixed mechanically to the ground, requiring no scanning or movement. Separation of the antennas up to 1,000 feet was considered a suitable field arrangement, considering practical leveling and construction techniques.

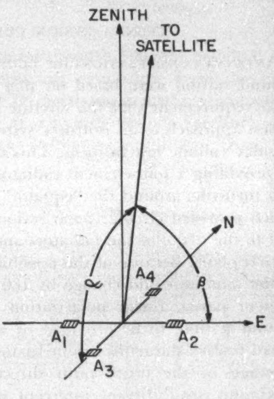

Fig. 2. Addition of another baseline for complete determination of angular position of satellite.

Based on these factors, an operating frequency was next considered. The higher the frequency selected, the less trouble would be caused by the ionosphere, and, within reason, the lighter the circuit components within the satellite could be. Also, the higher the frequency, the shorter the baseline between antenna pairs, allowing a possible reduction in size of the ground station. However, at lower frequencies, larger ground station antennas could be used for a given antenna beam pattern, thus providing greater system sensitivity, while at the same time providing greater power conversion efficiency within the satellite itself. As a compromise, a frequency in the range of 100 to 150 mc was initially considered, which was modified to 100 to 135 mc when it was found that transistors available at that time (about 1½ years ago) would provide usable power only up to 135 mc. The actual operating frequency now allocated to this system

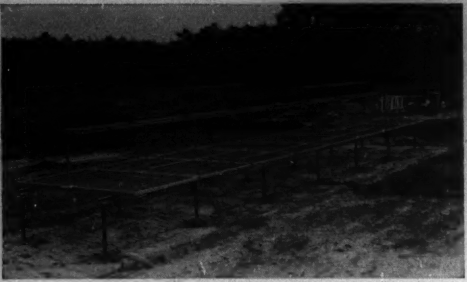

Fig. 3. Ground receiving antenna system.

by the Federal Communications Commission (FCC) is 108.00 mc, a previously unassigned parcel between the commercial FM band and the aeronautical navigation band.

ANTENNA DESIGN CRITERIA

ANTENNA CONSIDERATIONS for both the satellite and the ground station were based on this frequency. It was a basic requirement that the satellite antenna provide the closest approach to an isotropic system, with the smallest angular volume lost in nulls. This requirement was met by providing a four-element radiator system in the form of a turnstile, around the "equator" of the satellite ball, which provided circular polarization in a direction normal to the plane of the radiators and linear polarization in that plane. Because of the possibility that the attitude of the satellite could change by 180 degrees during subsequent passes, linear polarization was selected at the ground station, to be provided by an array of elements aimed toward the zenith. In order to provide the greatest coverage in the north-south direction, providing the maximum possibility of intercept of the satellite as it passed over the station meridian, the array is only one element wide in this direction. In the east-west direction, an array of 60-foot dimension was allowed, to provide the required gain by reducing the beam width in this direction. The resulting antenna consists of an array of 8 driven frame radiating elements (Fig. 3), mounted above a ground screen approximately 10 feet north-south by 60 feet east-west. The beam pattern resulting from this antenna is a fan-beam oriented with the major axis in the north-south direction, the beam being slightly more than 100 degrees north-south, and 10 degrees east-west, measured at the 6 db points. The detail of an individual radiating element is shown in Fig. 4.

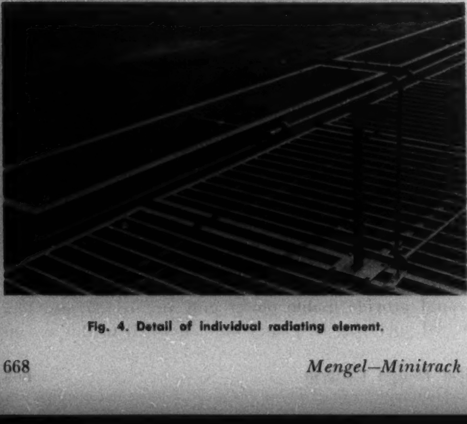

Fig. 4. Detail of individual radiating element.

With this antenna system, a loss of 3 db is incurred because of transmitting from a circular radiation system into a linear receiving system. When the elements of the ground receiving antenna are within, but aligned normal to, the plane of the satellite turnstile antenna, signal loss can be expected. Also, because of the so-called Faraday effect within the ionosphere, whenever the satellite is oriented so that the plane of the antenna elements includes the ground receiving station, the received polarization is essentially linear, and the plane of polarization could therefore be rotated by the ionosphere so as to arrive at the receiving antenna orthogonal to the elements, again causing signal loss. Because the probability of alignment according to these two conditions is relatively low, estimated at 20% or less, no attempt has been made to guarantee signal reception under these conditions.

Fig. 5 shows a layout of a complete Prime Minitrack antenna system utilizing eight antennas of the type just described. The basic arrangement of this system is a cross with 500-foot legs. Four antennas at the extremes of this cross provide the fine measurement of the system. The two at the ends of the north-south leg provide north-south measurement, and the two at the ends of the east-west leg provide east-west measurement. Because of the broad north-south antenna beam of 100 degrees, two sets of ambiguity resolution antennas are required in this direction. A single antenna pair provides the medium ambiguity resolution in the east-west direction—all that is required in the east-west antenna beam of 10 degrees.

These ground receiving antennas were designed primarily to provide a known phase center that can be referenced in the layout of the antenna field. Drift of this center, or variation in its position with respect to the angle of incidence of the received signal would cause serious system errors and must, therefore, be designed against. A single antenna array utilizes eight driven-frame-type radiators arranged in a balanced corporate feed structure. By controlling the impedance of the feeds in this structure, the amplitudes and phases of each element can be controlled, and tested for, thus providing a phase pattern that does not vary by more than 1 degree of phase in the distant field anywhere within the 6 db points of the beam pattern. By balancing at the length of each feed line from each antenna of a pair to the Minitrack trailer, by burying these cables two feet in the earth to provide temperature stability, and by eliminating all but the most necessary connectors in the feed lines, it is hoped that a useable long-time line stability can be achieved so that frequent checks of line lengths will not be required. All r-f lines to be used on this system will be either bead-supported air-line, or spiral-supported line.

PRIME MINITRACK SYSTEM

The electronics for the Minitrack System are made in two types. The basic and most complete type, known as the Prime Minitrack System, utilizes phase comparison at a low audio frequency, converting the signals from each of a pair of antennas to a 500-cycle signal by using a special local oscillator technique.

Output data will consist of: (1) the fine angular data (the north-south and east-west direction cosines of the satellite position) in digital form read out 20 times per second, with the time of readout accurate to better than a millisecond; (2) these same two fine angles plus the three ambiguity-resolving angles in analog form to provide ambiguity resolution of the "fine" digital angles; (3) signal level from the two fine-angle channels; and (4) time in the form of a serial code based on a 24-hour interval read onto the record every six seconds for positive time reference of every recorded event. A block diagram of this system is shown in Fig. 6, for one antenna pair phase comparison channel. It should be borne in mind that five such phase comparison channels are used in the complete Minitrack Station as follows: (1) east-west "fine," from the east-west 500-foot baseline; (2) north-south "fine," from the north-south 500-foot baseline; (3) east-west medium ambiguity resolution, from the east-west 64-foot baseline; (4) north-south medium ambiguity resolution, from the north-south 64-foot baseline; and (5) north-south coarse ambiguity resolution, from the

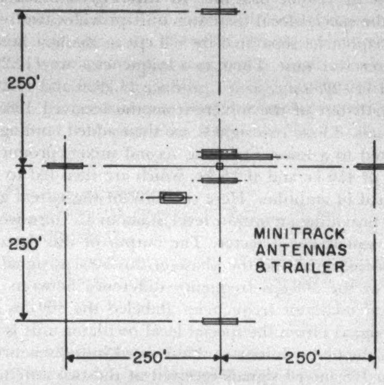
250'
250'
MINITRACK
ANTENNAS
& TRAILER
250'
250'

Fig. 5. Layout of Prime Minitrack antenna system.

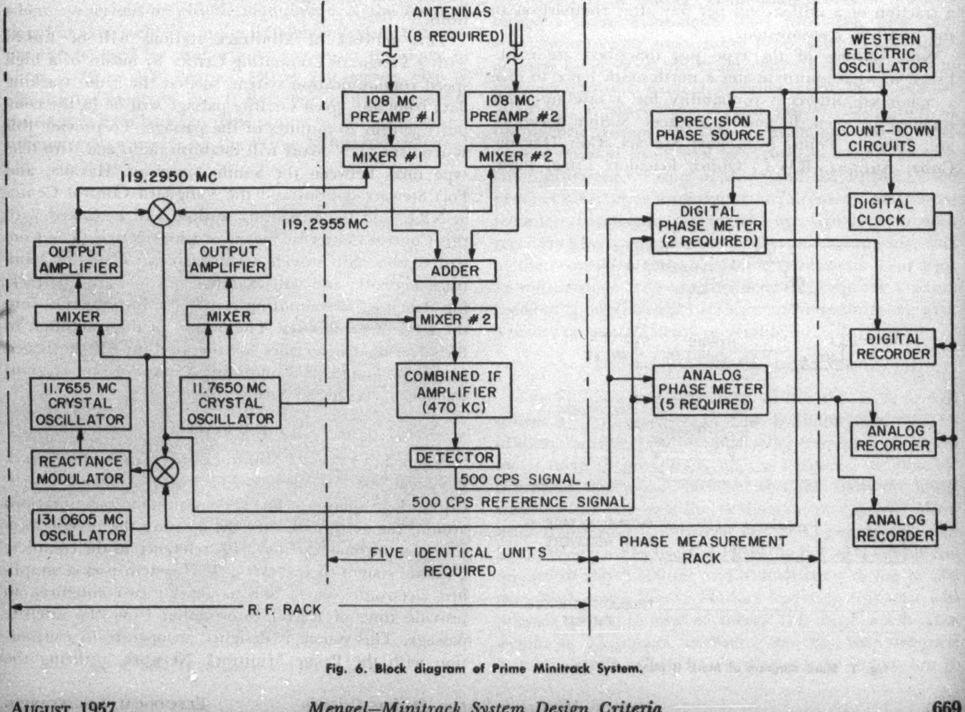
ANTENNAS
(8 REQUIRED)
108 MC PREAMP #1
108 MC PREAMP #2
MIXER #1
MIXER #2
119.2950 MC
119.2955 MC
OUTPUT AMPLIFIER
OUTPUT AMPLIFIER
ADDER
MIXER
MIXER
MIXER #2
11.7655 MC CRYSTAL OSCILLATOR
11.7650 MC CRYSTAL OSCILLATOR
COMBINED IF AMPLIFIER (470 KC)
REACTANCE MODULATOR
DETECTOR
500 CPS SIGNAL
500 CPS REFERENCE SIGNAL
131.0605 MC OSCILLATOR
WESTERN ELECTRIC OSCILLATOR
PRECISION PHASE SOURCE
COUNT-DOWN CIRCUITS
DIGITAL PHASE METER (2 REQUIRED)
DIGITAL CLOCK
DIGITAL RECORDER
ANALOG PHASE METER (5 REQUIRED)
ANALOG RECORDER
ANALOG RECORDER
FIVE IDENTICAL UNITS REQUIRED
PHASE MEASUREMENT RACK
R. F. RACK

Fig. 6. Block diagram of Prime Minitrack System.

north-south 12-foot baseline. In this Fig. 6 block diagram, the special local oscillator unit provides two oscillator frequencies separated by 500 cps to the first mixers of the receiver unit. These two frequencies are 119.2950 mc and 119.2955 mc, which produce 11.2950 and 11.2955 mc signals out of the mixers from the received 108.000 mc signals. These two signals are then added, and again converted to a lower i-f in the second mixer, producing signals of 470 kc and 469.5 kc, which are then fed to the combined i-f amplifier. Here the bulk of the system gain occurs, providing an output level of about 15 volts, which feeds a square-law detector. The output of this detector is a 500-cps signal and the phase of this 500-cps signal referred to the 500-cps frequency difference between the two local oscillator frequencies (labeled the 500-cps reference signal) from the special local oscillator unit is the same as the phase difference that existed initially between the two 108 mc r-f signals received at the two antennas. These signals then feed the phase measurement rack, where they are compared in phase, and both analog and digital outputs of the phase differences are generated. All digital phase measurement readings are controlled in time from the outputs of a precision time standard rack, which is basically a standard Loran timing oscillator, Western Electric type *0-76A/U*, with count-down circuitry and with receivers to provide frequency comparison to a standard frequency transmitter, such as station WWV at least once a day. The timing accuracy of this unit, after a three-week aging period, is better than a fraction of a millisecond per day after comparison to the standard transmission.

Nine stations of the type just described are established in what approximates a north-south fence to give a maximum intercept probability for a satellite orbit inclined between 30 and 40 degrees. Station locations are: Blossom Point, Md.; Fort Stewart, Ga.; Havana, Cuba; Antigua, B.W.I.; Quito, Ecuador; Lima, Peru; Antofagasta, Chile; Santiago, Chile; and San Diego, Calif. An additional station will be established in Australia, and two additional stations similar to these, but with low-gain, wide beam antennas, are being established on Mayaguana and Grand Turk Islands in the British West Indies. In the case of these last two stations, the minimum weight of the transmitter unit in the vehicle makes it the most preferable method of range instrumentation for tracking the third stage of the launching vehicle during the test vehicle series. By means of triangulation techniques, missile velocity will be determined from the angle vs time data from these two stations.

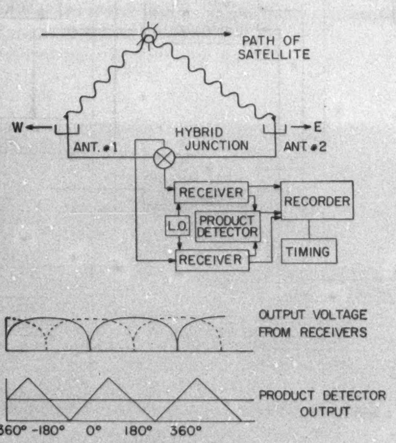

Fig. 7. Block diagram of Mark II Minitrack System.

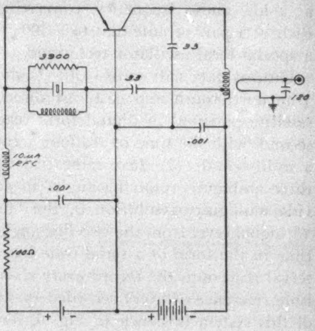

Fig. 8. Simple Minitrack transmitter.

This network of Minitrack stations will be linked with a Vanguard Computing Center by means of a high speed communication system, so that the radio tracking data from any given satellite passage will be in the computer within 20 minutes of the passage. To provide this system, the U. S. Army will establish radio and wire teletype links between the South American, Havana, and Fort Stewart stations and the Vanguard Control Center at NRL, and the remaining stations will be linked with this Control Center by means of wire teletype. The Control Center will provide technical control of the Minitrack network, and will examine and forward all tracking data to the computing center for introduction into the IBM *704* computer. The output of the computer, in the form of ephemerides for the satellite will be issued from the Vanguard Computing Center to the various tracking activities requiring this data.

MARK II SYSTEM

A DIFFERENT TYPE of Minitrack system called the "Mark II System," has been designed to provide a means of measuring the satellite orbit at more numerous locations around the earth and, thereby, measure the precise location of additional stations with reference to the complete geodetic system of the earth. This system uses a simplified electronic system and as few as two antennas, to provide time of transit information from the satellite passage. This system is designed to operate in conjunction with the Prime Minitrack Network, utilizing the data from this network for ambiguity resolution, thereby eliminating the need for more than four antennas for complete measurement of the satellite passage. The Mark II System is designed for use by universities, professional groups, and advanced amateur radio clubs throughout the world. It is felt that it will be suitable for obtaining accurate and useful information at many locations where complete Prime Minitrack stations are not feasible. A prototype of a complete Mark II Minitrack Station has been built by the U. S. Naval Research Laboratory. Drawings and data from this prototype unit will be made available to any prospective user of this type of system, in an effort to increase the total number of Minitrack measurements around the world.

The Mark II Minitrack System is based on the use of phase comparison techniques between the two r-f signals received. A block diagram of a typical Mark II System is given in Fig. 7. Here, the signals from each antenna pair are combined in a hybrid junction, which has the property of giving a zero-signal output from one terminal for a radio path length difference of 180 degrees (one-half wavelength), and a zero-signal output from the other terminal for a radio path length difference of 360 degrees (one full wavelength). Each of these two terminals feeds a low-noise, amplitude modulation receiver, the outputs of which feed a product detector. The output of this detector provides accurate zero signal crossings at the radio path length differences corresponding to 0, ½ wavelength, 1 wavelength, etc. In normal operation, where no serious amplitude modulation of the received signal at extremely low audio frequencies exists, this output can be used for proportional data over the range of about —30 to +30 degrees, 150 to 210 degrees, 330 to 390 degrees of phase, etc. It does not, however, provide continuous data between these points, which is the major difference between it and the Prime Minitrack System.

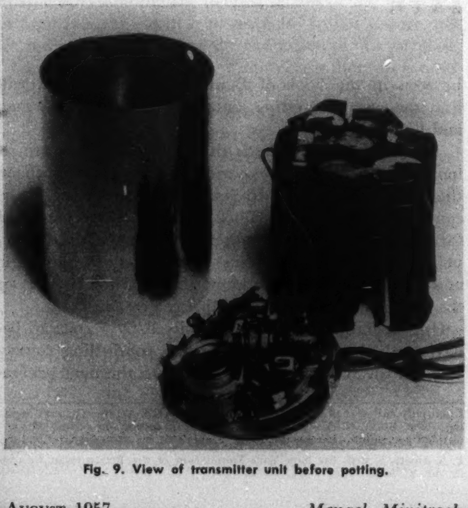

Fig. 9. View of transmitter unit before potting.

The complete Mark II System for a single antenna pair thus includes an r-f hybrid junction fed directly by the two antennas, two low-noise 108 mc amplitude modulation receivers using a common local oscillator, a product detector, an audio amplifier, a recorder unit suitable for recording at least two and preferably four channels of data, plus time, a time standard receiver, and the required antennas. For those locations not close enough to receive the WWV, WWVH, or other standard time signals consistently, an auxiliary precision crystal clock unit is desirable to guarantee the availability of standard time during every tracking event. If a more austere approach to this system is required, an antenna system made up of an array of folded dipoles made of television twin-lead or open wire transmission line feeds will suffice, with lumped constant hybrid junctions. The receivers can be normal good quality communications receivers using a common local oscillator, plus preamplifier-converter units using tubes such as the *6BY4* or even *GL-6299* in the front ends. If the system is to provide scientific data, a recorder must be available; otherwise, a panel meter would provide indication of the satellite passage. Suitable recorders must have a frequency response of at least 10 cycles per second, and include provision for time marking and the output of the product detector as a minimum requirement. Additional recorder channels to provide the agc signals from both receivers plus a second time marker on the opposite side of the record are desirable. Time resolutions of at least 25 milliseconds are recommended; this requires a paper speed of approximately 1 inch per second minimum, with 3 inches per second being preferable.

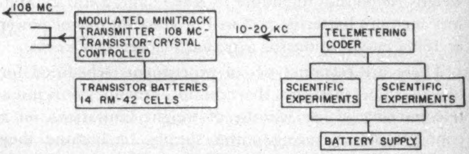
108 MC
MODULATED MINITRACK TRANSMITTER 108 MC-TRANSISTOR-CRYSTAL CONTROLLED
10-20 KC
TELEMETERING CODER
TRANSISTOR BATTERIES 14 RM-42 CELLS
SCIENTIFIC EXPERIMENTS
SCIENTIFIC EXPERIMENTS
BATTERY SUPPLY

Fig. 10. Block diagram of transmitter showing dual function of tracking and telemetering data from the satellite.

THE MINITRACK TRANSMITTER

THE MINITRACK TRANSMITTER within the satellite will utilize a crystal controlled vhf oscillator powered by Mallory mercury cells. An operating frequency of 108.00 mc is used, to provide as high a frequency as possible consistent with good efficiency and the resultant lower weight within the satellite. A diagram of a simple Minitrack transmitter is shown in Fig. 8. The transistor used is the Western Electric *GA-53233;* it has an α cut-off frequency of above 500 mc and a dissipation rating of 200 mw. With seven *RM-12* Mallory batteries, this unit will provide about 15 mw of power for three weeks at a weight of 13 ounces, excluding antenna and external heat shields. It is 2 inches in diameter by 2¾ inches in height. This unit is shown in Fig. 9 before potting.

In addition to the basic function of tracking the satellite, the r-f portions of the Minitrack System serve as the r-f link for telemetering data from the satellite. Fig. 10 shows a block diagram of a satellite transmitter which will provide continuous telemetering during the life of the Minitrack transmitter.

This unit is 5½ inches in diameter by 4⅝ inches high, weighs 7.8 pounds including 18 *RM-42* and 2 *RM-12* Mallory mercury batteries, and will produce 80 mw of power at 100% modulation for a period of over two weeks.

There are certain types of experiments scheduled for use in these satellites that cannot provide continuous telemetering, either because of weight limitations on a continuously operating power supply, or because they require a dumping signal periodically. For these experiments, a command turn-on receiver will be incorporated in the satellite. This unit will receive a command turn-on signal with two fixed audio tones from the ground and actuate a relay in its output circuit. Actuation of this relay will connect the power supply batteries to the scientific experiments and to the telemetering coder for a period of about 30 seconds, modulating the modulated Minitrack transmitter for this period.

CALIBRATION TECHNIQUE

To CALIBRATE the Minitrack System, a method of calibration using optical techniques will be used. A special polar-mounted camera using an *f/5.0* 40-inch ultralinear lens will be mounted at the exact three-dimensional center of the Minitrack antenna configuration. During nighttime operations, a high flying airplane will carry a Minitrack transmitter together with a radio-controlled flashing light that is commanded to flash about every second from the ground Minitrack station. When this plane is flown across the Minitrack antenna beam, the camera photographs the position of the flashing light on the plane against the star background, thereby permitting post-flight reduction of the photographic image to provide the airplane position to the order of 2 seconds of arc. Such calibration runs will be made about every month at each tracking station, using specially trained calibration teams. More frequent checks of the Minitrack System will be obtained by measuring the position of the sun and several of the radio-stars by using them as radio sources of calibration position. Unfortunately, their angular sizes are too gross to give the ultimate system precision required, but significant information in the field of radio astronomy may be obtainable in this way.

The Values and the Danger of Codes

P. S. HEATH

Codes, rules, and regulations, when not woven into the inner life of a person, lose their meaning and will not withstand turbulent or catastrophic experiences. One of the chief responsibilities of the engineering profession is that of establishing codes which tend to foster the development of the highest ethical convictions in the individual.

EVERY GREAT EXPANSION of human endeavor and every great creative experience seem to result in codes of conduct the purpose of which is to bring order into that endeavor or into the burst of life resulting from the creative experience. The Hebrews, having been delivered from enslavement in Egypt, and having accepted that deliverance as by the hand of God, sought to put into an elaborate code the obedience which this act of deliverance demanded. Much of the result can be seen in the book of Deuteronomy where you will find some very interesting canons on the subject of a man and his work.

The danger with codes is that the farther they are removed from the initial experience which fathered them, the more unrelated and irrelevant do they become to the contemporary situation. They tend to become hard and formal and traditional rather than inward and compelling and persuasive. Jesus' "Ye tithe mint and anise and cumin but ye leave undone the weightier matters of the law, justice, mercy, and faith," is a case in point.

Our forefathers, by and large, lived by a code of behavior which sprang from an inner compelling conviction. As the code was handed down to the next genera-

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Essentially full text of an address given at the AIEE Winter General Meeting, New York, N. Y., Jan. 21-25, 1957, at a session on ethics. Recommended for publication by the AIEE Committee on Professional Conduct.

P. S. Heath is with the New York Foundation of the Presbyterian Church in the U. S. A., New York, N. Y.

tion, the standard still held some compulsion but the original inner experience which gave rise to the code was lost. The new generation was to some degree held on course by what the sociologists call a psychological gyroscope. Then a following generation quite removed from the original source loses the gyroscope and the standard becomes increasingly meaningless.

This indicates the danger into which codes of behavior fall. A rather pathetic example of this is seen in the athletes who a year or so ago abandoned the honor system and cribbed in examination. Here was an iron-clad code, rigid, demanding, absolute. But it had lost the inner compulsion because it was tradition-directed and had never been woven into the inner life of the students. Thus, codes which are not given continual interpretation, making them immediately relevant to the situation at hand and thereby claiming inward acceptance, lose their meaning and their hold. Codes which are the result of tradition, or are imposed from without or from the top down, will not stand the test of turbulent or catastrophic experience. Codes or canons have value as they are expressive of an inner conviction which derives from the acceptance of the meaning of life. One young minister in New York City, working in a difficult slum area and concerned especially with drug addiction among young people, makes the appalling statement that drugs to many of these young people become "the sacrament of the meaninglessness of life." Drug addiction is, as it were, the normal behavior which follows the acceptance of a hopeless and defeated view of life. Human behavior is based upon the accepted context of life: What is the meaning of my life in my profession? What am I willing to live for? What am I willing to die for?

Well, the ultimate meaning of life lies beyond life—it lies in a man's relation to his Creator. Man is a part of Creation, he is not the Creator. He must find the purpose of his life in the purpose of his Creator for him. Man has been fashioned with all the wonderful powers he has, capable of fathoming the deepest secrets of the universe, for a purpose. If a man is to reach his fullest stature, his life and work must become the expression of this purpose.

I am stressing this because I am certain that our canons of behavior will have vitality and the capacity to grip and mold our behavior only as they are contemporaneously expressive of this ultimate purpose in life.

Well, how can we make and keep our canons expressive of the highest professional standards and morally compelling upon our profession in the immediate situation? I think that there is considerable merit in proposals to use the method of practical case study. Daily problems and questions that are troubling us will keep our ethical principles fresh. Then the codes which we formulate may become not so much specific commands or solutions as a construction of the ultimate principles that will provide the tests by which our behavior will be judged.

THE ENGINEERING PROFESSION

Assuming the background of which I have been speaking, it follows that the engineering profession has a responsibility to pursue the highest form of creativity. This provides both the fulfillment of one's own God-given creative talents and also one's responsibility to the family of which he is a part. To do excellent work is an essential ethical quality in a creative person.

Again, a basic characteristic of an engineer who is fulfilling his life purpose is integrity. To lead people to false conclusions, to allow pride or ambition or covetousness to compromise the strictest integrity, is betrayal in an engineer. To be known as the strict advocate of truth at any cost—this is the foundation of an engineer's professional life.

There is also the principle of sacrifice as it applies to an engineer. Fulfilling the purpose of one's professional life requires that one's own well-being shall not be the primary concern, but rather one's contribution to society as a whole, in keeping with ultimate purpose of the Creator. Like the health pioneer who bares his arm to the fever-laden bite of the mosquito, the chemical or civil or electrical engineer is called upon to act in accordance with claims upon him that go beyond his own advantage or even his personal safety.

The decisions which engineers and physicists have had to make in connection with the expansion of nuclear power are extraordinarily difficult, and do not lend themselves to solution by any simple code of behavior. Men will differ as to how they should respond to a particular situation. But the world will be farther ahead if men differ out of deep inner convictions, than if they are agreed because some superior power says: "Do this." An ethical canon which provides for vital, living, inner response is better than one that is static and lifeless with no inner persuasion, as often those are which have been handed down from above or from long ago.

Again, an engineer who is relating his work to an eternal purpose will learn to cultivate attitudes of mutuality, co-operation, and professional fellowship. This may not be easy in a profession which frequently encourages a "lone wolf" type of personality. But we can never be isolated individuals; we belong to a community of people engaged in common pursuits. We need to learn the disciplines as well as the joys of group participation, of sharing with each other our achievements, our problems, our failures. Our codes should point up the principles, but the applications should be left to the immediate situation.

Enough has been said to make my point, i.e., that fixed and detailed codes which rapidly become removed from existential experience can become an encumbrance with little effect on current conduct. The air is filled with such codes: election practice codes, fair employment codes, movie producer codes, college football codes, entertainment decency codes, etc. "Everyone wants to get into the act"—and if everyone does, the act can get pretty cluttered up. But if our canons can define simply the basic principles of the acceptance of a meaningful interpretation of life and these can be supplemented by on-the-spot group fellowship discussions of particular situations, then it seems likely that a developing experience of responsible behavior which may permeate the entire profession will be produced.

Electronic Controls as Applied to Process Instrumentation

A. D. ENTWISTLE

The use of electronics in the measurement and control of process variables usually results in higher production rates as well as higher quality at lower costs. Among the advantages are ease of measurement, high speed of response, and the ability to transmit information over long distances.

THE BIG NEWS in the International Geophysical Year, which we have entered, is the plan to launch a number of earth satellites to circle the earth, collecting information. These satellites were designed using electronic computers, and will be launched and controlled electronically. They will collect their data by electronics and electronically transmit their information back to earth. In these days of earth satellites, computers, and guided missiles, the problems of applying electronics to industrial processes appear by comparison, but by comparison only, a simple chore. The application, justification, and maintenance of control systems can be extremely complex. The rewards, though, are many—in higher quality at lower costs and through higher production rates with no increase in the labor force.

APPLICATION

THE MEASUREMENTS of process variables, the control of these factors, and the indication of their quantity is a rough definition of process instrumentation. These process variables include temperature, pressure, level and flow, as well as pH, specific gravity, speed, and torque.

There are three general methods used to measure and control a process. They can be purely mechanical, pneumatic, or electronic. These also may be used in combination. Mechanical control such as float valves and self-acting temperature valves provide admirable service in many control systems. The use of pneumatics has been widely accepted in many control problems from simple processes to complete chemical plants. This acceptance is not without excellent reason. The dependability, repeatability, and ease of maintenance of pneumatic control are well known.

Where then does electronics fit in? In general, electronic process instrumentation is useful in cases where (1) the measurement can be made more easily electrically; (2) the required speed of response is very fast; (3) the transmission of information over long distances is required; and (4) an electrical output is required to control or analyze.

There is hardly a process variable that cannot be measured electrically, although this is not always the easiest or most economical method. There are process variables which must be detected by electrical means. Redox potential, pH and the whole field of infrared analyzers fall into this category. These instruments can be an invaluable tool in the control of chemical processes. The analyzers measure the amount of radiation absorbed by a gas or liquid. Every material absorbs at certain definite wave lengths, and the amount of absorption will be proportional to the percentage of the constituent in the sample. The analyzer is calibrated to be sensitive to the frequency band of the substance involved. Therefore, it can be used as a continuous check on either the quantitative or qualitative factors which affect product cost and quality. They are also used as a continuous check on the quantity of valuable or dangerous material lost in off gases or liquids.

When a choice exists as to the method of detecting a variable, many other factors must be considered. The most common variable is temperature. This may be detected by the variation in physical conditions of a liquid, vapor, or gas, or it may be measured with a thermocouple, resistance thermometer, or radiation pyrometer. If it is desired to measure a large number of similar temperatures, the thermocouple offers a reliable and economical method. Very high or low temperatures are handled by electrical means with ease and the small size of a thermocouple can be advantageous.

The physical conditions of hazardous or high-pressure materials can be measured safely by numerous electrical means. The level may be found by weighing the tank with a load cell or by measuring conductance with an electric probe. By detecting the variation in radiation from a radioactive source transmitted through the material, the level in a completely enclosed vessel can be found. The flow of these same materials may be measured by an electromagnetic flowmeter or a turbine flowmeter with an electromagnetic revolution counter.

A complete line of electronic transmitters, controllers, and recorders is on the market, which is quite similar to the pneumatic line. In many cases this can be a very satisfactory method of controlling a process.

In addition, electronic controls are useful when fast control response is required. This is important in close speed control, or where long distance significantly extends the time of response of pneumatics.

Another factor to be considered is the length of trans-

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mission, which becomes very important in telemetering applications. Examples of these applications are pipe-line operations, as well as unattended control stations, as used in microwave or power distribution systems.

We have covered the cases where measurement is more satisfactory electrically. We also have the condition where the final control required is electrical. Motor control is the most common of this type: constant speed, constant torque, or control of these factors based on other information. If the inherent regulation of the motor is not close enough we must use control, constant speed by tachometer feedback and constant torque by current control of either a d-c motor or an eddy-current clutch. The speed can also be controlled by other factors. For example, pH can be maintained by varying the speed of a metering pump. An interesting example of torque variation is a center-wind wind-up operation, as used in wire and film machines—this as opposed to the surface winder used in the textile trade. As the roll builds up, both the speed of the mandrel and the lever arm or roll diameter are continually changing. Various methods are used to adjust the unit to maintain the correct torque at all times. Dancer rolls on the material give constant tension, and tachometers on the mandrel can be fed back to give a variable tension pattern. The armature voltage necessary to maintain a given current in a d-c motor can be used as a very good measure of the variation in roll diameter.

A recent development has been a computer which, when fed a large number of process variables, can solve the process in terms of predetermined equations. It, in turn, corrects the variables to maintain any given production rate in perfect balance. The automatic refinery is not impossible.

MAINTENANCE

THE MAINTENANCE of electronic equipment presents a number of problems, some general to all maintenance and some peculiar to the trade.

Electronic equipment, with the exception of its weakest link, the vacuum tube, is usually freer of failures than most other devices. The life of the components is long if they are properly designed. Compared to brush wear and bearing life, maintenance on electronic equipment should be negligible. The life of the transatlantic cable including tubes is designed to be 20 years. The vacuum tube is the weakest link, but the failure pattern for any type in a given application can be determined. A tube, if it does not fail in the first 48 hours, can be assigned a minimum life and an average life. The initial failure rate, although not high, can be avoided in critical applications by "burning in" the tube before installation. A study should be made of a tube's life in a given installation, and the cost of the tube failure versus the cost of the tube should be carefully compared so that a reasonable replacement policy can be instituted. There are many instances where an expensive tube can be removed in time from a critical application and then burned to failure in an expendable operation. In one operation, a tube failure might upset a continuous process for hours, whereas the same failure in an intermittent process would cause no trouble. The predictability of tube life makes scheduled preventive maintenance possible and the ease of changing tubes makes this type of maintenance inexpensive and the controls very reliable.

Unfortunately, although the life of the components may be long, weaknesses do show themselves and problems do occur. The most insidious, the most disrupting, and the most difficult to find is the intermittent fault. This is the trouble that has plagued radio repairmen for many years and, more recently television servicemen. The most effective way of dealing with this type of fault is through experience.

For example, one of our machine controls went haywire, disrupting production. By the time we were summoned and arrived, the machine was running normally again. Saturday afternoon a phone call informed us of a repeat of the same trouble. The trouble disappeared. At 3 a.m. a week and half later the same trouble occurred, but it had corrected itself when we arrived. Many tests were run to no avail, with the trouble recurring when no one was there. It was half seriously suggested that our continuous attendance would be insurance the trouble would not recur. Finally, one Saturday afternoon about a month after the first indication of trouble, the machine was caught in the act. Testing at this time indicated an intermittent ground in the circuit. This was the big break but further work was necessary to find the culprit. When it was found that squeezing a plug-in relay reproduced the fault, the relay was changed and the trouble permanently corrected.

Two weeks later a second machine exhibited the same erratic operation. After a brief check, an electrician replaced the corresponding relay and cleared up the fault with a minimum of disruption to production.

This brings up the problem of who is to maintain the equipment. Plant electricians, in most cases, are untrained in electronics. In addition, the average electrician is incapable of assuming the responsibility of trouble-shooting anything more deeply than tube replacement. There are two reasons for this. First, the average electrician has learned his trade by apprenticeship, often with little or no technical training. His electrical practices are rule of thumb, not logic. The second is that failures are so far apart and so varied that adequate practice is impossible.

There are a number of answers. The intricate maintenance can be and usually is put on the shoulders of the engineer. When production is stopped this is the most successful immediate relief. However, it is important to train others for the job. The engineer is often likely to be transferred to other sections where he would be unavailable. His regular duties also suffer during the times of trouble.

The acquisition of a technically trained nongraduate, preferably with considerable practical electronic trouble-shooting experience, will give the plant an expert who is not likely to be transferred or promoted to another job. This man must be fitted into a regular job, as most installations do not merit a full time trouble-shooter. He can be used as an electrician or more logically an instrument mechanic.

Many large cities have companies which specialize in both scheduled and emergency maintenance. They can supply experts on call to assure uninterrupted operation. Suppliers are also important sources of help but often are miles away.

In a more general nature, complete trouble-shooting charts and detailed maintenance write-ups can aid repair of the faulty equipment no matter who is called upon to service the control. This consists of a step-by-step procedure for locating a fault. It should be drawn from manufacturer's recommendations, plus additional studies by plant personnel, plus known weak points found through experience. A detailed study and record of normal operating conditions, voltages, and wave forms, become invaluable during improper operation. Unusual occurrence reports should also be recorded and publicized among maintenance personnel.

Where it can be justified either by the importance of an operation or by the number of identical units, a complete spare unit is invaluable. It allows minimum down time and scheduled maintenance. The spare unit can be arranged to be switched in, plugged in, or rewired in, depending on the complexity of the system.

In general, electronic control requires very little maintenance, aside from scheduled tube replacement. Some types of troubles can be more difficult to locate.

It is true that people remember troubles longer than they remember good operation, a fact which may result in the development of a lack of confidence in electronics. This gives a real selling job to the engineer. The manager who has had even occasional trouble with his television set becomes extremely reluctant to trust the operation of a million-dollar process to the new art, and one period of erratic operation is enough to shake a management's confidence in the entire field. The selling must be on the basis of economic or quality justification. A reassurance that the dependability is high must sometimes be given by showing actual maintenance cost figures.

After justification and installation comes another critical period. Most controls need adjustment, particularly in a new application, where stability and many other factors need setting. It is at this time that many a production man has been heard to mutter, "Take this junk out; our old machine works better than this." Very close tie-in between production and engineering is needed to locate and correct operating problems. After the initial shakedown, the system becomes dependable, good operation commences, and complaints disappear.

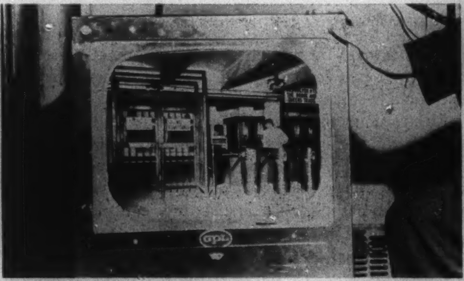
After a fault has occurred and has been corrected, a time sets in when every irregular item is a source of complaint whether it occurred previously or not. These can usually be resolved and the accepted normal condition returns, with no further complaints occurring.

A particular selling job is needed when an analyzer is purchased to replace an existing laboratory method. In many cases, the analyzer, a basically repeatable device, must be calibrated by use of an existing laboratory method. This old method may have experimental errors which can cause a wide divergence in results. It is immediately apparent that the calibration graph is not a straight line but a scatter of points. One of the methods is in error. The correct line can be solved by statistical methods, but it is difficult to sell the idea that a meter on a cabinet is correct while the careful titration that a department has depended upon for years is wrong. Continuous analysis also shows up variations in plant streams that spot sampling can never show. Faith in the new tool can be built up only by careful explanations and repetitive checking.

CONCLUSIONS

THE JUSTIFICATION for any application should be on the economic and quality considerations alone. If the maintenance is taken into account, it should be as a favorable point for electronics. The life of the only doubtful member can be accurately determined, and its unscheduled failure largely prevented. Although preparation should be made for unusual failures, the units normally give years of life with no attention required. The widespread acceptance and application of electronics to process instrumentation is proof of their worth. Large investments of money are solely dependent on the electronics from the bottom of the Atlantic to the circling satellites above. The safety of millions of people depends on the reliability of electronics—in industry, transportation, and defense. Preparedness is the only prerequisite necessary to apply electronics to any given plant.

TV "Polices" Subway Gates



A closed-circuit television system has been installed on an experimental basis by General Precision Laboratory of Pleasantville, N. Y., to study possibilities for increased efficiency in New York City subway operations.

Mounted on a ceiling beam, a small camera is focused on exit gates in the concourse of the Independent Division's 42nd St. station at 8th Ave. Pictures of the area are carried via coaxial cable to a 17-inch monitor screen in a change booth 175 feet away. The present installation is designed as an aid in spotting riders who attempt to enter the gates without passes. Also being considered is its use to police platforms, particularly at night and in little-used stations, as a deterrent to crime.

A Technique for Reactor Flux Profile Measurements

A. E. KLICKMAN F. R. DEFALCO

THE METHOD of determining a neutron flux from measurements made on materials which have been activated by the flux has been used successfully by many people. The activation technique that has been used to measure the flux profiles in several new reactor cores is described here.

In the reactor core under consideration, a measurement of the flux profile along a line parallel to the vertical axis of the core was desired. To measure this profile, a long tube of Zircaloy 2 extending from the top of the reactor vessel to the botton of the core was placed in the reactor and used as a vertical well. The inside diameter of this well is 0.210 inch and the total length is 20 feet. The reactor was a high-power pressurized water reactor so that the measurements had to be made at high temperatures and in high fluxes. Because it would be difficult to position foils in the well accurately and it would take a long time to make enough foil measurements to obtain a complete flux profile, a technique using the wire of the material to be activated appeared to be a solution. A length of wire can be positioned in the core accurately and enough data for a complete flux profile can be obtained quickly.

The device developed in this program for measuring spatial distribution of neutron flux consisted of a 0.010-inch diameter magnesium with 0.01 a/o (% by atoms) indium wire strung inside a tube of either magnesium or magnesium with 33 a/o cadmium. Runs using each of the tubes permit an evaluation of both the thermal and epithermal neutron fluxes. In operation, the wire and tube were attached to a long aluminum-handling rod. A disk was attached to the handling rod to locate the wire-tube assembly axially in the reactor core well and to actuate an electric timer. The arrangement of the assembled device in the core well is shown schematically in Fig. 1.

The second major component developed in this program is the scanning bench for measuring the activation of the wire after irradiation. It consists of two lead-shielded reel mechanisms, a lead collimator, a scintillation counter, and a timing-and-driving unit. These were designed so that the activated wire can be wound onto one reel and then counted automatically as it passes from one reel to the second reel by the collimator-counter assembly. The timing-and-driving mechanism moves the wire intermittently at the rate of 1 inch per 15 seconds. At the end of each 15-second period, the number of counts recorded during the period is printed out automatically, the scaler reset, and the wire advanced 1 inch.

The operating procedure developed is as follows:

1. The wire-tube assembly is placed in the reactor core well and irradiated for a period of time. The actual time used in these tests was 1 minute, but it is a function of the neutron density and will vary with the reactor.

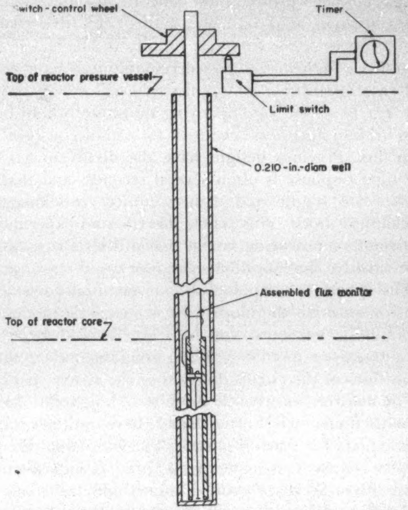


Fig. 1. Cross-sectional view of flux-measuring device in reactor.

2. The wire-tube assembly is removed from the core, and the wire is wound into one of the reel mechanisms.
3. One hour after removal from the reactor, the wire is processed through the scanning bench and the activity is measured. The 1-hour period is observed to allow the decay of extraneous activities.

In in-pile tests, it was found that when the procedure outlined in the foregoing is used, a 1-minute irradiation in a thermal neutron field with a density of 4.38×10^8 neutrons per cubic centimeter would produce 2.30×10^5 counts per 15 seconds.

In order to determine both the thermal and epithermal fluxes, the counting data from a wire irradiated in magnesium tube and a wire irradiated in a magnesium–33 a/o cadmium tube must be available. The former wire will give a measure of the total flux and the latter wire a measure of epithermal flux, and their difference can be used to determine thermal flux, using results of in-pile tests.

Digest of paper 57-405, "A Wire Activation Technique for Reactor Flux Profile Measurements," recommended by the AIEE Committee on Nucleonic and Radiation Instruments and approved by the AIEE Technical Operations Department for presentation at the 2nd Nuclear Science and Engineering Conference, Philadelphia, Pa., Mar. 11-14, 1957. Scheduled for publication in AIEE *Communication and Electronics*, 1957.

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Solid-State Neutron-Flux Measuring System

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FOR CONTROL of a nuclear reactor, ionization in a gas has been utilized most generally for detection purposes because the output of a neutron-sensitive gas-filled ionization chamber responds rapidly to changes in neutron flux and, hence, to the corresponding reactor power.

Neutron-sensitive thermopiles that utilize the temperature rise in a solid accompanying transmutation of boron into lithium have also been used for measurement of neutron flux. Previous designs have the disadvantages that the time response is often several seconds, and that the devices are fragile and, hence, subject to damage by mechanical shock. This article describes an experimental neutron-flux-measuring system that utilizes a rugged neutron-sensitive thermopile designed for rapid response.

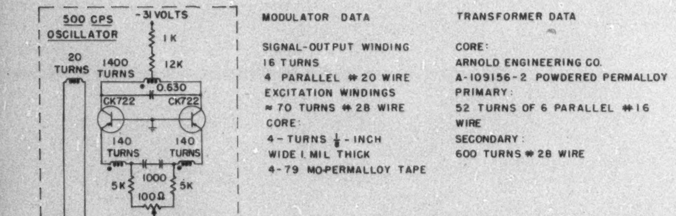
The system is composed of four essential parts: (1) a neutron-sensitive thermopile, (2) a magnetic modulator, (3) an excitation source for the magnetic modulator, and (4) a transistor amplifier. These components are shown as portions of the circuit diagram of the system in Fig. 1.

The neutron-sensitive thermopile is designed to have a response time much shorter than 1/10 second, in order to be adequate for reactor control. The individual thermocouples consist of a sequence of three ⅝-inch diameter disks, the outer disks being bismuth and lead, and the inner disks being the neutron-flux-to-heat converting material, a boron-impregnated powdered copper disk 0.006-inch thick. These disks are stacked in a long repeating sequence of 100 thermocouple sections to form a thermopile of mechanically simple and rugged construction. The thermopile was subjected to steady-state and transient tests in the nuclear reactor at the Brookhaven National Laboratory. The measurements indicate that the thermopile, which has a resistance of ¾ milliohm, produces an output signal of 21 microwatts into a matched resistance load when placed in a position in the reactor for which the unperturbed neutron flux is 3.8×10^{12} neutrons/cm^2/sec. From oscillograms, the exponential response time constant of the thermopile to a step function of neutron flux is estimated at 37 milliseconds.

The second-harmonic magnetic modulator was designed for an input resistance of 10 milliohms and a time constant of 25 milliseconds. Mo-permalloy cores are used and the time-constant specification requires that a cross-sectional area of 2.6×10^{-3} cm^2 be used.

The basic tuned stage of the transistor amplifier consists of common-emitter degenerative stages. In each stage, the degeneration is made frequency-selective by use of an *LC* series-tuned circuit between emitter and ground, tuned to a frequency near the second-harmonic frequency. The fourth stage of the amplifier is untuned.

Experimental data on the behavior of the over-all system are not available. On the basis of the measured performance of the individual components and of appropriate assumptions, however, the over-all system may be expected to have a maximum sensitivity of 9×10^{-11} rms amplifier output volts per neutron per cm^2 per second, a response time of 45 milliseconds, and a rated maximum neutron flux of 4×10^{12} neutrons per cm^2 per second (unperturbed). The output of the amplifier is adequate to excite existing electronic drivers for control-rod actuators. Consequently, this system is believed to be a step toward more reliable, longer-lived reactor control equipment.



MODULATOR DATA

SIGNAL-OUTPUT WINDING
16 TURNS
4 PARALLEL #20 WIRE
EXCITATION WINDINGS
≈ 70 TURNS #28 WIRE
CORE:
4-TURNS ⅛-INCH
WIDE 1 MIL THICK
4-79 MO-PERMALLOY TAPE

TRANSFORMER DATA

CORE:
ARNOLD ENGINEERING CO.
A-109156-2 POWDERED PERMALLOY
PRIMARY:
52 TURNS OF 6 PARALLEL #16
WIRE
SECONDARY:
600 TURNS #28 WIRE

Fig. 1. Neutron-flux measuring system.

Digest of paper 57-407, recommended by the AIEE Committee on Nucleonic and Radiation Instruments and approved by the AIEE Technical Operations Department for presentation at the 2nd Nuclear Engineering and Science Conference, Philadelphia, Pa., Mar. 11-14, 1957. Published in AIEE *Communication and Electronics*, July 1957.

T. S. Gray and R. H. Spencer are with the Massachusetts Institute of Technology, Cambridge, Mass.; W. H. Grim, Jr., is with General Electronic Laboratories, Inc., Cambridge, Mass.; F. S. Replogle, Jr., is with the Schlumberger Well Surveying Corp., Ridgefield, Conn.

Harold H. Beverage 1956 Lamme Medalist

Dr. Beverage, holder of many patents and co-inventor of the wave antenna and diversity system for high frequency reception, has been awarded the 1956 Lamme Medal " . . . for his pioneering and outstanding engineering achievements in the conception and application of principles basic to progress in national and world-wide radio communications."

GARVER LAMME
1924
THE ENGINEER
VIEWS HOPEFULLY
THE HITHERTO
UNATTAINABLE

History of the Medal

C. W. FRANKLIN
FELLOW AIEE

THE LAMME MEDAL, which is to be awarded to an outstanding member of the AIEE today, is one of three medals established by Benjamin Garver Lamme in his will.

Mr. Lamme was born near Springfield, Ohio, January 12, 1864. He had been chief engineer of the Westinghouse Electric Corporation for many years prior to his death on July 8, 1924. During his lifetime he, also, had been the recipient of similar awards, one of which was the "Edison Medal" from the American Institute of Electrical Engineers.

He understood the recognition and interest such a medal provides, to the recipient first of all, but perhaps more important, to the profession, or group involved, as a whole. The advancement of the engineering profession through education and through incentives toward greater accomplishment and better living for mankind were uppermost in his thinking.

In addition to this medal which AIEE awards for "Meritorious achievement in the development of electrical apparatus or machinery," Mr. Lamme established a similar medal to be awarded by the Society for the Promotion of Engineering Education, for "Accomplishment in technical teaching or actual advancement in the art of technical teaching"; and also a medal for "Meritorious achievement in engineering or the mechanical arts," to be presented to a graduate of one of the technical departments of his alma mater—Ohio State University. In addition to these awards, he set up two engineering scholarships to be awarded each year to Ohio State University students.

All of this is indeed appropriate for a man to do, who had attained the high professional standing and who commanded the great respect of his fellowmen, as Mr. Lamme certainly had. He was extremely successful as a designer of direct-current machinery, alternate-current generators, synchronous converters, induction motors, single phase railway motors, and a host of other such machinery. Mr. Lamme also made important contributions to electrical system designs. He could foresee how the equipment he developed would be required and used in a complete system from the power source to its utilization.

Following graduation from the university, his work with Westinghouse began early in 1889. He, therefore, began his professional career only five years after the organization of AIEE. This placed him near the beginning of the period of initial developments for our earliest systems and machinery in the electrical industry. We are fortunate to have had such a man become one of the great leaders of our profession and to have had him see fit to establish a medal which we can award each year. The quotation inscribed on the medal, "The Engineer Views Hopefully the Hitherto Unattainable," is from his own words and states well the guide for Mr. Lamme's lifework.

The 29th presentation of the Gold Medal, together with a bronze replica thereof, is to be made today, for the year 1956. It is to be made to a man, who, through his outstanding work in his specialized field has most certainly contributed a full measure toward providing that better living for mankind, toward which Benjamin Garver Lamme did so much for us.

Career of the Medalist

E. W. ENGSTROM
FELLOW AIEE

IT IS A HEARTWARMING and rewarding experience to take part in a program honoring a good friend and associate for outstanding achievement. I have known and worked closely with Harold Beverage for more than 25 years. During those years, I have acquired a deep affection for him and a profound respect for the profes-

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Presentation and acceptance addresses given at the Lamme Medal ceremony held during the AIEE Summer General Meeting, Montreal, Que., Canada, June 24-28, 1957.

C. W. Franklin, Consolidated Edison Company of New York, Inc., is chairman of the AIEE Lamme Medal Committee.

E. W. Engstrom is senior executive vice-president, Radio Corporation of America, New York, N. Y.

sional merit which is being recognized today in this presentation of the Lamme Medal.

Harold H. Beverage was born in 1893 in North Haven, Me., a small community located on an island in Penobscot Bay. He studied electrical engineering at the University of Maine, where he received his B.S. degree in 1915, and in 1938 his alma mater honored him with the degree of Doctor of Engineering.

Immediately after his graduation, Harold Beverage found a stimulating environment in which to commence his long and fruitful career in the field of radio communication. Joining the General Electric Company in Schenectady, N. Y., he went to work in the radio laboratory under Dr. E. F. W. Alexanderson. Here, he was given a broad scope under the tutelage of a man who was an outstanding figure in the development of radio communications.

A critical problem in those early days was the reception of transatlantic radio signals. It was to this problem that young Harold Beverage was assigned. Dr. Alexanderson had devised the "barrage receiver," essentially a directional antenna system consisting of two long wires with which interfering signals emanating from various directions could be balanced out and prevented from interfering seriously with the desired signal. Testing this system at the U. S. Naval Radio Station at Otter Cliff, Me., in 1919, Harold Beverage discovered peculiar differences in the reception quality of the two antenna wires. He launched into a concentrated effort to determine the reason. The result of this work was the achievement in the following year of the Beverage wave antenna. This simple, single antenna which in its physical appearance resembled a 10-mile rural telephone line combined a number of features of importance to transoceanic radio communication. It was aperiodic for all practical purposes. It was not only highly directional, but unidirectional. The phantom height of the antenna was several thousand feet, yet it required only such low supports as were dictated by mechanical expediency. This was because the earth under the antenna provided electrical characteristics resulting in wave tilt to build up a cumulative signal. This development was of basic importance in speeding the growth of long distance commercial radio communications. For Harold Beverage, it was but the first of many outstanding contributions to the advance of radio.

During World War II, when long wave radio was needed for certain very special purposes and where high towers were out of the question, this same Beverage wave antenna was successfully adapted to transmission as well as to its earlier use as a receiving antenna.

During his studies leading to the wave antenna, he had been assigned by Dr. Alexanderson to direct a program of field research in radio reception for the newly formed Radio Corporation of America (RCA). Dr. Alexanderson himself had been appointed chief engineer of the new company. In his new role, Harold Beverage established himself with a few colleagues at Riverhead, N. Y., near the eastern end of Long Island, on a site later occupied by the RCA transatlantic receiving station. Harold Beverage described his assignment at Riverhead as one of "perking up reception," an extremely modest reference in view of the achievements which followed.

During the middle 1920's, long-distance radio began its move into the short-wave areas of the frequency spectrum. And here again, a major contribution by Dr. Beverage played a role of vital importance. In the autumn of 1923, listening to a transmission from KDKA in Pittsburgh, Pa., he discovered the phenomenon of diversity effect in selective fading. In co-operation with H. O. Peterson, a member of the Riverhead staff, he conducted tests which indicated that the fading occurred in random fashion for receiving antennas situated only a short distance apart. These tests led Beverage and Peterson to the development of the diversity reception system, in which two or more antennas spaced a short distance apart effectively overcome the problem of local fading in the reception of high frequency radio signals.

With the growth of long-distance radio communications and the expansion of RCA, Dr. Beverage's responsibilities and range of activities mounted steadily. In 1929, RCA Communications, Inc., was established as a subsidiary of RCA, and Harold Beverage was appointed chief research engineer. In this capacity, he directed and participated in a series of major developments on all branches of radio communication. Among these were the first commercial very-high-frequency communications system, installed in Hawaii in 1930; and the first television relay system, developed for television field tests between New York, N. Y., and Camden, N. J., in 1934.

In 1940, Harold Beverage's effectiveness as an administrator and innovator was recognized with his appointment as vice-president, research and development, of RCA Communications. In addition, he was named director of the radio research laboratory of RCA Laboratories Division upon its formation in 1942. He exercised, with outstanding competence, the responsibility of directing a broad program of research and engineering over the entire field of long-distance radio communications.

Dr. Beverage's service to his profession is matched by his service to his country. During World War II, he traveled far and frequently, visiting the various theaters of operation to solve critical problems of communication. His advice and guidance were responsible to a large extent for the effectiveness of the North Atlantic communications system which enabled the United States to ferry thousands of combat planes to the European theater. Likewise, his guidance was invaluable in the area of electronic countermeasures.

Over the years in which he has provided both leadership and inspiration to others in his field, Harold Beverage has been recognized with many honors and awards, both by his profession and by his country. It is most fitting that he should receive today the Lamme Medal of the American Institute of Electrical Engineers. Now, may I address brief remarks to Dr. Beverage:

> Bev, it was your good fortune to enter the field of radio during the pioneering days of communications. You have seen radio as a communications service ex-

pand to the radio-television-electronics industry, touching as it does nearly every phase of our life. To this growing science, art, and industry, you contributed much to its advance. This recognition today is evidence of the value of your achievements and the esteem of your contemporaries. That you have performed well is self evident, and we are here today to do you honor. All this, however, places added obligations upon your shoulders for the cycle must continue. By your example and by your encouragement, you will continue to provide the steppingstones for a succession of younger research workers. It is here that you will find new and ever-greater opportunities.

Harold Beverage has made a life-long study of how electromagnetic waves find their way around and what it takes to make efficient use of the radiations. By his untiring efforts, he stands recognized as a world authority on radio wave propagation.

Mr. President, it is with deep pride and admiration that I now present to you Harold H. Beverage, explorer of the radio wavelengths and outstanding pioneer in radio communications, as the Lamme Medalist for 1956.

To Harold H. Beverage ". . . for his pioneering and outstanding engineering achievement in the conception and application of the principles basic to progress in national and world wide radio communications."

Co-operation in International Radio Communication

H. H. BEVERAGE

FELLOW AIEE

IT IS WITH A GREAT DEAL of pride and appreciation that I accept the Lamme Medal. I also feel very humble when I consider the accomplishments and high standing in their respective fields of those who previously have received the medal. I feel especially privileged to be included in that group so highly honored by the AIEE. I am also mindful of the fact that this award is not for me alone, but is a great tribute to loyal and ingenious engineers who have been associated with me over the years.

My interest in radio communication extends back almost 50 years to 1908 when I built my first receiver, winding the tuning inductance on a round oatmeal box, which was standard practice among radio amateurs of that time. The detector was the usual catwhisker and galena combination. My home town was a small island situated off the coast of Maine. Most of the inhabitants were fishermen or farmers. Wireless, as it was called then was relatively new, and some of my neighbors were not quite convinced that it was possible to pick up messages out of the air. My grandmother was among those who expressed considerable doubt. Maine is traditionally a Republican stronghold, but there were three Democrats in my home town and my grandmother was one of them. Accordingly, she was much interested in the progress of the Democratic Party. One evening I copied a press message which I thought would interest her. A few days later when the Boston paper arrived on the Island, it contained the identical press release in detail. My grandmother was finally convinced that it was really possible to pick messages out of the air. She gave me a $5 gold coin, which I still consider as my first Gold Medal for achievement.

DR. HAROLD H. BEVERAGE (*center, right*) receiving the 1956 Lamme Medal Award from AIEE President M. S. Coover (*center, left*) as Dr. E. W. Engstrom (*left*) and C. W. Franklin (*right*) look on.

In 1916, I was transferred from the General Electric test department to Dr. E. F. W. Alexanderson's Laboratory in Schenectady, and was privileged to assist in the development of the Alexanderson system of transoceanic telegraphy which was later to play such an important role in the formation of the Radio Corporation of America. The alternator frequencies for transoceanic communication ranged from about 14,000 to 28,000 cycles, overlapping the frequency range which today we would call high fidelity audio.

The first Alexanderson alternator was installed at New Brunswick, N. J., in 1917, and was operated with outstanding success by the U. S. Navy for communication with the American Expeditionary Forces in France during World War I. The Navy turned New Brunswick over to the Radio Corporation of America on March 30, 1920, when it went into commercial operation with England. Other stations were soon put into operation to Europe and also to transpacific points from a station near San Francisco.

The low frequency spectrum suitable for transoceanic communication was limited, and was sometimes troubled by atmospheric static from thunderstorms during the summer months in spite of the large reduction in static accomplished through the use of directive reception.

The Radio Corporation of America co-operated with Guglielmo Marconi and others in observing long distance

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transmissions on the so-called short waves which came through well at night. In October 1924, Marconi tuned his transmitter at Poldhu, Wales, down to 32 meters (9.4 mc), and the startling discovery was made that the signal came through during the daylight hours as well as at night. In 1925, one of my associates built a transmitter which operated at 15 meters (20 mc) which was highly successful in handling traffic with South America. Up to that time, communication with South America using the very low frequencies had been very difficult inasmuch as the static originated in the same direction as the signals and directive reception was not very effective. Further developments by many organizations indicated that frequencies from 3 to 30 mc were useful for long distance communication at some portion of the day and at various seasons. The problem of the heavy static on the very low frequencies had been substantially overcome by the introduction of the high frequencies, particularly during the daylight hours. However, the high frequencies were troubled by frequency variations and fading which frequently made it necessary to transmit each word twice for aural reception by an operator. The frequency variation problem was minimized by using a quartz piezo electric crystal oscillator and raising the frequency to the desired value by frequency multipliers. The fading problem was minimized by the discovery that the fading was random between antennas spaced a few hundred feet apart. A space diversity system was devised which, in effect, automatically selected the receiver having the strongest signal. The development of the high frequencies made it possible to establish a truly world-wide radio communication system on an economic basis.

In comparison with the very low frequencies, the high frequency spectrum seemed unlimited. However, in a few years, the high frequency spectrum was becoming congested. In order to handle more traffic, it became necessary to make better use of these frequencies. Developments in this direction took such forms as time division multiplex systems, and the substitution of teleprinter for Morse code operation. A 7-unit constant ratio teleprinter code was developed which printed an error symbol when an incorrect number of signal elements was received. In co-operation with the Netherlands Posts and Telegraphs, this system was further developed to lock up the system both ways and automatically request a repetition of a character mutilated in transmission, thereby making it feasible to use page printers. This system is known as automatic ARQ.

The next step to make better use of the frequency spectrum for international radio communication was the adoption of single sideband techniques utilizing subcarriers, each equipped for space diversity reception. Time division multiplex of two to four teleprinter channels is applied to each subcarrier. With this arrangement 16 or more 60-word per minute teleprinter channels are accommodated on a single transmitter.

The aforementioned developments made it feasible to provide leased channels to the Government and private agencies. It also made possible a customer-to-customer teletypewriter service. Any customer equipped with a teletypewriter can establish direct connection with the office of a customer similarly equipped in some 30 foreign countries.

In most countries outside of the United States, the international telegraph business is a government monopoly, usually associated with posts and telegraph organizations. Obviously, the services mentioned would not be feasible without close co-operation between the international agencies involved. For example, agreement is required on the characteristics of the subfrequencies for single sideband operation. For the customer-to-customer teletypewriter service, there must be correspondence between the teletypewriter keyboards. Where this is not the case, automatic converters are required to make the keyboards compatible.

The demand for radio communication is expanding rapidly, and much remains to be done to make more efficient use of the limited radio spectrum in order to accommodate all of the services that require radio communication and navigation. Here is a challenge to the young generation of engineers familiar with solid-state physics, radio astronomy, and scatter propagation. In these phenomena, and in other phenomena as yet undreamed of, lie the prospect of ever more effective world-wide communications.

Combining these advances with the rapid development of all of our electronic techniques, we may fit within the limited radio spectrum tomorrow such services as international television, highly portable personal communications systems, and even the remote control of our ships and aircraft from electronic traffic centers at main terminals on either side of the ocean or across the continent.

It would be a fascinating exercise to try to guess the specific achievements for which you will be awarding the Lamme Medal in the years ahead. It happens, however, that only one prophecy can be made with complete assurance. To each of the future recipients, the award will mark an especially proud moment in his professional career. I know, for I speak now from personal experience. Thank you.

Previous Award Winners

1928	Allan Bertram Field
1929	Rudolf E. Hellmund
1930	William J. Foster
1931	Giuseppe Faccioli
1932	Edward Weston
1933	Lewis B. Stillwell
1934	Henry E. Warren
1935	Vannevar Bush
1936	Frank Conrad
1937	Robert E. Doherty
1938	Marion A. Savage
1939	Norman W. Storer
1940	Comfort A. Adams
1941	Forrest E. Ricketts
1942	Joseph Slepian
1943	A. H. Kehoe
1944	S. H. Mortensen
1945	David C. Prince
1946	J. B. MacNeill
1947	A. M. MacCutcheon
1948	V. K. Zworykin
1949	C. M. Laffoon
1950	Donald I. Bohn
1951	Arthur E. Silver
1952	I. F. Kinnard
1953	F. A. Cowan
1954	Aldo M. deBellis
1955	Clinton R. Hanna

Revised American Standard for Lightning Arresters

H. R. STEWART
FELLOW AIEE

The revised American Standard for lightning arresters for a-c power circuits from 120-volt through 230-kv circuits is discussed.

IN APRIL 1957, there became available a revised American Standard for lightning arresters for a-c power circuits, ASA-*C62.1-1957*, AIEE No. *28*. It covers arresters for a-c power circuits from the familiar 120 volt lighting circuit up through 230-kv circuits. Arresters for 345-kv circuits are not yet included since the insulation levels (BIL) associated with this voltage are not yet published by the appropriate standardizing bodies. The standard covers arresters which are mounted integrally with transformers such as "completely self-protecting" distribution transformers, as well as those separately mounted. Arresters for signal circuits such as fire-alarm, railway signals, supervisory control, carrier-current equipment, telephone and telegraph equipment, and radio and television antennas, are not covered; nor are those for d-c power circuits such as 600-volt street railways or 125/250-volt and 250/500-volt distribution circuits.

The revised standard supersedes the 1944 issue. In preparation for the revision much work has been done, first by the Protective Devices Committee (and its subsidiary groups) of the AIEE, the sponsor organization for this standard, and then by the ASA *C-62* Sectional Committee on Lightning Arresters which consists of delegations from AIEE, Electric Light and Power group, National Electrical Manufacturers Association (NEMA), National Bureau of Standards (NBS), and communications and railroad interests. In 1950, the AIEE activity produced a "Report on Lightning Arresters for Alternating Current Power Circuits, AIEE 28-A" which included recommended revisions of the then existing ASA *62.1-1944*, AIEE No. *28* on valve arresters, and included recommended revisions and expansion of the then existing AIEE No. *24* (1940) on protector tubes and AIEE No. *47* (1945) on expulsion arresters thus combining all a-c arresters in one Standard. This was further revised by AIEE in 1956 in "Report on Lightning Arresters for Alternating Current Power Circuits, AIEE *28B*" and the changes with the reasons therefor are covered in detail in AIEE Transactions Paper 56-636, by Armstrong, Defandorf, and Opsahl. Concurrently, ASA *C62* Sectional Committee on Lightning Arresters had been working since 1952 on an international arrester standard through the International Electrochemical Commission and through its liaison with AIEE. This cross-fertilization of ideas with foreign countries contributed to some of the revisions adopted in AIEE *28B*.

The revised American Standard *C62.1-1957* AIEE No. *28* is largely based on AIEE *28B-1956*, and on the NEMA "Standards of Lightning Arresters" of 1952 and including its revisions through March 1953. An examination of it will show it to be complete to a degree befitting a manufactured product which is as far from being "tailor-made" as a lightning arrester. When a user orders an arrester by catalog number from a manufacturer claiming his product to be in accordance with American Standards, he can rightly expect: (1) that the design will be capable of withstanding impulse and wet and dry 60-cycle flashover tests, 60-cycle sparkover tests, high impulse current tests of short duration, low impulse current tests of long duration, and "duty cycle" tests, at values and by test methods all as detailed in the standard; (2) that the design will have protective characteristics in accordance with the manufacturer's claims if tested by methods detailed in the standard; (3) that acceptance tests, if ordered, will be in number, type, and method of application as designated in the standard; (4) that the amount of nameplate information will be not less than that specified in the standard; and (5) that construction as to mounting arrangements, protection of ferrous parts, and size of terminal and lead arrangements will conform to the requirements of the standard.

This list will be recognized as covering all the essential features of arrester performance of interest to the user, both with regard to providing recognized and uniform methods for determining the quality of the arrester as a protective device for other equipment and also with regard to standardizing values, materials, and test methods which indicate its own endurance and self-protecting ability. The value to the user in being thus assisted to compare competitive offerings on the basis of such standardized features should be obvious. The value to the manufacturer in having standardized steps of voltage rating and a standardized array of other characteristics such as impulse current withstand value corresponding to various arrester types is that the number of ratings and types manufactured tend to remain at a practical minimum through ability to resist temptation for intermediate ratings which would be special and which would raise costs for the manufacturer and ultimately for the industry as a whole.

R. Stewart is with the New England Power Service Co., Boston, Mass.

MAJOR DIFFERENCES

Most of the major differences in the revised standard from earlier documents have been described in the AIEE Transactions Paper 56-636 by Armstrong, Defandorf, and Opsahl referred to previously. The additional major differences between the revised American Standard and AIEE *28B-1956* are as follows:

1. Arresters are classified by name instead of by selection from standardized arrays of impulse withstand currents and, in the case of valve arresters, of impulse discharge currents at which duty cycle tests are made. These names are "station," "intermediate," "distribution," and "secondary-type" for valve arresters, and "protector tube" and "distribution-type expulsion arrester" for the expulsion variety. These will all be recognized as type-names of long standing in the industry with the exception of "intermediate-type." This was substituted for the previous "line-type" because the latter was a misnomer in that line-type arresters have almost entirely been used in substations rather than on lines. Each type-name is tied in the standard to specific ratings and certain performance values. For example, station type valve arresters are assigned standardized voltage ratings from 3 kv through 242 kv, are tested for 100,000 amperes impulse discharge current short duration withstand, 150 amperes long duration withstand, and at 10,000 amperes impulse discharge current during the duty-cycle test.
2. The requirements as to power factor and rate of rise of recovery voltage of the test circuit in the duty cycle tests on expulsion-type arresters have been relaxed somewhat until further data has been obtained which may lead to a future revision of the standard in these respects.

Two features have intentionally been excluded:

A. Whereas the proposed international arrester standard mentioned will contain specified limits of protective performance to which the United States delegation has agreed in deference to common standards-making practices abroad, the American Standard does not contain such quality requirements. It leaves to the workings of the competitive system the securing of optimum balance of protective characteristics and economy.

B. Whereas the proposed international arrester standard will contain an application guide, technical material of this sort is not viewed in the United States as part of a rating and test specification, and may be found in a broader treatment of lightning protective devices and measures of various kinds entitled "Report on Lightning Arrester Applications for Stations and Substations," Conference Paper 57-22, by a Working Group of the AIEE Protective Devices Committee.

In conclusion, the reader's attention is directed to the economic importance of arresters and the impact of standardization on the arrester art. While relatively inexpensive themselves, arresters have a material effect on the cost of the vastly more expensive equipment which they protect in that the needed insulation level of the protected equipment, insofar as it is determined by voltages other than the power frequency voltage, is geared to the protective excellence of the arresters. The preparation and publication of an arrester standard does not directly produce protective excellence in the marketed product, but by bringing together the practitioners of the various phases of the arrester art, this process promotes widespread understanding of the issues involved and unquestionably accelerates improvement in the protective performance of lightning arresters and a corresponding cost reduction in the protected equipment.

Nuclear Reactor Nears Completion

The construction of the Organic Moderated Reactor Experiment (OMRE), being conducted for the United States Atomic Energy Commission by Atomics International, a division of North American Aviation, Inc., is essentially completed, the company announced recently. The objective of the OMRE, which is located at the Atomic Energy Commission's Reactor Testing Station at Idaho Falls, Idaho, is to prove the feasibility of a power reactor moderated and cooled by a hydrocarbon.

Shown are the housing which covers the top of the reactor vessel (at the left), and the air-blast heat exchanger (at the right).

The cooling system will circulate 7,200 gallons per minute of organic coolant from the reactor to the air-blast heat exchanger which, in turn, will expel the 16,000 kilowatts of heat generated in the reactor core to the atmosphere.

The Organic Moderated Reactor Experiment is a important part of the Atomic Energy Commission's long range program for the development of economical pow from nuclear energy.

Safety Circuit Development at Brookhaven

J. E. BINNS
ASSOCIATE MEMBER AIEE

W. LONES
ASSOCIATE MEMBER AIEE

D. G. PITCHER

M. MELICE

IN SPITE OF EFFORTS to design nuclear reactors which will be intrinsically safe from an uncontrolled increase in the rate of power generation, it remains the primary problem of reactor instrumentation to provide a safety circuit, sensing neutron level, which will safely limit such excursions and yet not impose an undue burden on operation by reason of accidental "scrams" due to instrument failure. At Brookhaven National Laboratory, the philosophy of these safety circuits has recently been overhauled in the light of operating experience and a thorough-going redesign has been completed. The following features, in line with this thinking, have been incorporated into the new system:

1. A reasonable amount of effort has been expended to make the circuits free from failure.
2. A reasonable amount of effort has been expended to make the circuits fail-safe.
3. Hourly automatic testing drastically reduces the risk from unsafe faults.
4. Three independent safety channels are employed in a "two out of three" coincidence connection in order to insure adequate protection, together with reasonable freedom from accidental scrams.
5. No means are provided for disabling any of the three safety channels.
6. Means are provided for disabling the automatic testing for short spaces of time only.
7. Operator can clear faults rapidly by plugging in a complete new channel.
8. The state of the system and the results of the operability tests are continuously and directly presented to the operator, who, therefore, is in a position of knowledge and responsibility. Consequently, division of responsibility can be avoided.
9. The inverse period signal is added to the power signal in order to make the circuit trip with less period signal as the power increases.

One of the things which has been done to make the circuits more completely fail-safe is to include a 120-cycle monitoring signal in the circuit of each chamber which provides the power-proportional trip signal. This is obtained by incomplete filtering of the high-voltage supply for the chamber. The channel will trip in case of failure of the power supply; an open circuit in either the high-voltage cable, the signal cable, or the chamber; or of a ground in either the high-voltage cable or the signal cable.

The automatic testing is accomplished by use of a monitoring circuit, one of its functions being to switch he period recorder and the power recorder sequentially each of the three safety channels. This takes place on an hourly schedule. The recorder charts show the operator any discrepancy among readings of the three channels. They also show the results of automatic tests applied to a given channel during the time it was connected to the recorders. These tests are made by means of simulated power and period signals which cause the readings on the recorders to increase until the channel finally trips out. At this point, a mark is caused to appear on the chart, which becomes a permanent record of the result of the test. The simulated power signal consists of a ramp function current. In order to get a linearly increasing inverse period, however, it is necessary to insert a simulated chamber current of the form

$$i = A \exp a\, t^2$$

inasmuch as the period amplifier takes the time derivative of the log of this current. In order to obtain this form of current a special signal generator is provided. This employs a motor-driven potentiometer in a squaring circuit and a logarithmic diode similar to the one used at the input to the period amplifier.

The actual trip signal in each safety channel is composed of a signal proportional to reactor power plus a signal proportional to inverse reactor period. The first signal comes directly from an ion chamber; the second by way of the period amplifier. The trip condition is

$$\frac{T'}{T} + \frac{P}{P'} = 1$$

where

$T' =$ trip period at $P = 0$
$P' =$ trip power at $T = \infty$

The combined trip signal is indicated on a meter which is calibrated from 0 to 100% of trip point. The advantages of combining signals are the following:

1. Excursions of temperature resulting from increasing power can be made less dangerous, since the higher the power the sooner will the reactor be scrammed by a shortening period.
2. The operator can see on a single meter at all times how close the channel is to the trip point.
3. The operator can start up the reactor and level it off simply by holding the reading of this meter constant.
4. The equipment is simplified by the fact that only one trip circuit is needed for both signals.

This work was carried out at Brookhaven under the auspices of the U. S. Atomic Energy Commission.

Digest of paper 57-398, "Safety Circuit Development at Brookhaven National Laboratory," recommended by the AIEE Committee on Nucleonic and Radiation Instruments and approved by the AIEE Technical Operations Department for presentation at the 2nd Nuclear Engineering and Science Conference, Philadelphia, Pa., Mar. 11-14, 1957. Published in AIEE *Communication and Electronics*, July 1957.

J. E. Binns, W. Lones and D. G. Pitcher, are with the Brookhaven National Laboratory, Upton, N. Y.; M. Melice is with the Nuclear Development Corp., White Plains, N. Y.

A 2½-Year Demand Growth Cycle

C. R. CHAPMAN
MEMBER AIEE

In making predictions of future demand peaks, it is usually necessary to examine past data to determine evidence of trends and cycles. Studies of demand growth curves show the presence of distinct 2½-year cycles.

THE POWER DEMANDS on an electric utility system vary in a characteristic pattern throughout the year, with a winter demand peak caused by the longer hours of darkness and a summer peak attributable to air-conditioning loads. The anticipated annual peak is important in system planning, and every effort is made to predict future peaks as carefully as possible. Past records of annual peaks may not be of much help in these predictions, except to provide an average. Table I, which is based on data from the Public Service Company of Indiana, shows the percentage growth in annual peak demand for several years, and reveals little pattern that would be helpful in predicting future growth rates.

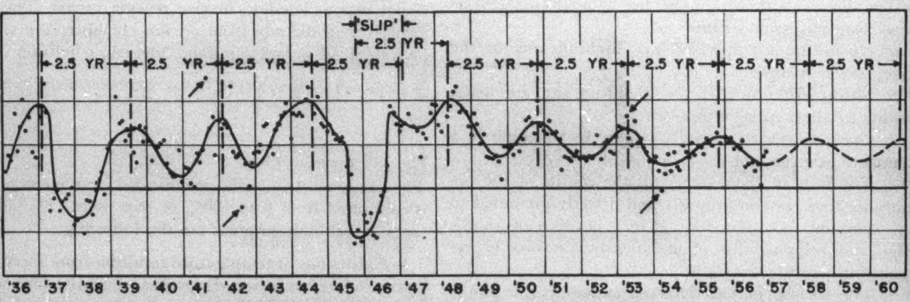

Fig. 1. The 2½-year demand growth cycle. Each point represents the per-cent increase in demand over the same month of the previous year. Arrows indicate typical paired deviations, as discussed in the text. Data is for the system of the Public Service Company of Indiana, Inc.

To investigate this further, the annual growth for each month, over the same month of the preceding year, was determined for this same system from 1936 to the present. The results, expressed as a percentage of the peak load for each month, are plotted in Fig. 1 and show a distinct 2½-year cycle. With the exception of a half-cycle "slip" at the end of World War II, this period has been maintained for 20 years.

Before proceeding with the discussion, it is important to make perfectly clear what type of curve this is. It is not a demand curve, but a curve of rate of growth of demand, with all seasonal variations removed. Each point represents the per-cent increase in demand over the same month of the preceding year. In commerce and business circles, curves of this sort are called "year-to-year relatives," and are usually plotted with 100%, 110%, and 120% taking the place of the zero, 10%, and 20% shown in Fig. 1.

Although a cycle is undeniably present, there is quite a bit of scatter of the experimental points. One technique sometimes used to minimize scatter is to use a "rolling average," where each data point is averaged with the one on each side of it, and then replotted. This has the same effect as drawing a smooth curve through the points, and was considered unnecessary. Another source of scatter in this type of plot is the tendency toward paired deviations, where an abnormal peak in any month will cause an abnormal low to appear for the same month in the next year, and vice versa. Two such pairs are indicated by arrows in Fig. 1, one occurring in the summers of 1941 and 1942 and the other in the springs of 1953 and 1954.

Table I. Annual Growth of Peak Power Demands

Year	1948	1949	1950	1951	1952	1953	1954	1955
Per-cent Increase	14.1	9.8	13.3	6.3	11.7	5.9	7.9	11.0

Data from Public Service Company of Indiana, Inc. All peaks occurred in November or December. The 1956 peak demand was about 900 megawatts.

Full text of District paper DP57-604, presented at the AIEE Great Lakes District Meeting, Des Moines, Iowa, April 15-17, 1957. Recommended for publication by the AIEE Committee on System Engineering.

C. R. Chapman is with Purdue University, Lafayette, Ind.

The author wishes to thank the Public Service Company of Indiana, Inc. and the Edison Electric Institute for making available certain data use in this article, and Prof. Irving Morrissett of the economics departme Purdue University, for assistance with business cycle information.

All of the large deviations from the curve can be explained in this way; in fact, one large error that was not paired was found during the preparation of the curves to be the result of a mistake in plotting. It should be noted that this tendency toward paired deviations is not cumulative, but disappears after affecting only two data points.

Not all of the scatter can be caused by paired deviations, inasmuch as extremes in temperature, excessive cloudiness, strikes, and other events are known to affect power system loading. Careful historical investigation along these lines would probably make it possible to modify the data slightly in order to reduce the scatter further. Although this would make a cleaner curve, it would not improve its reliability for forecasting, because each new month contains the possibility of producing new scatter.

The Public Service Company of Indiana system is well balanced between various types of loads, and might be expected to behave similarly to the national average. The Edison Electric Institute has compiled demand growth data for the entire country since 1949. This is plotted at the bottom of Fig. 2, showing that the cycle has been present in the national picture for at least three periods. This curve shows much less scatter, as would be expected for a larger sample; in fact, it can be seen that the scatter in Fig. 1 has decreased steadily over the years as the system has grown. The Edison Electric Institute compiles demand information for the eight Federal Power Commission regions individually, and examination of this data, which is not reproduced here, shows that the cycle is clearly present in five of these regions representing 80% of the total national demand. The cycle would, therefore, be expected to appear in most individual utility systems, although less pronouncedly for smaller systems or for those serving a special, nonrepresentative type of load.

The cycle was found to parallel the growth cycle of the Federal Reserve Board index of industrial production, which is reproduced in part at the top of Fig. 2. Thus, the demand cycle appears to be a reflection of total industrial activity, with the difference in amplitude of the fluctuations attesting to the greater stability of the power industry over industry in general. The industrial cycle is apparently the result of the operation of the law of supply and demand, with the period fixed by natural factors inherent in the economy, just as the period of any oscillatory system is a property of the system and shows up spontaneously in response to excitations of an entirely random nature. Historical events may increase the amplitude of the oscillations, and Government controls may help to damp them down, but only very severe stress, such as that in 1945, has disrupted the period of the cycle.

When the data of Table I is re-examined as a part of the cycle, the apparently random variations become understandable as part of a pattern. The use of the cycle, on systems where it is present, makes possible a minor improvement in utility peak-load forecasting. From the extrapolation shown in Fig. 1, it may be expected that the annual peaks, although still occurring in the winter, will not again show a high increase over the previous annual k until 1960, and then not again until 1965. Similarly, wa

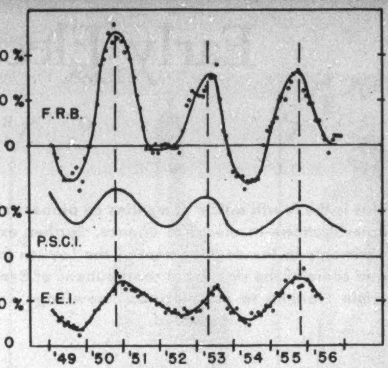

Fig. 2. A comparison of three growth cycles. The vertical dashed lines are 2½-year intervals.

F.R.B.—Federal Reserve Board index of industrial production, year-to-year relatives. P.S.C.I.—Reproduction of a portion of the Public Service Company of Indiana curve shown in Fig. 1. E.E.I.—Demand growth from the Edison Electric Institute, similar to that of Fig. 1, but for the entire United States.

an unusually heavy summer demand may be expected in 1958. If the summer peak on this system is to exceed the winter peak within the next few years, it will most likely do it in 1958.

The 2½-year cycle deserves to be included among the factors to be considered when demand predictions are made. As a further indication of this, the curve of Fig. 1 was originally plotted in July 1956, and the data accumulated during the ensuing months can be seen to follow the cyclic pattern satisfactorily.

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Mobile Tracking System

The Telescopic Photographic Recorder (TPR), capable of photographing an object 2 inches by 7 inches at an altitude of 4 miles, has been delivered to the Air Research and Development Command's Air Force Armament Center at Eglin Air Force Base, Fla. Developed and built by the Perkin-Elmer Corporation, Norwalk, Conn., it is the nation's first completely mobile high-performance optical tracking system.

Early Electrical Machines

BERN DIBNER
FELLOW AIEE

This is the fourth article of a series on pioneering investigations in electrical science.* Further experiments in the development of the Leyden jar and some of the significant contributions of Benjamin Franklin to our electrical knowledge are recounted.

FEW FIGURES STAND OUT more prominently among the experimenters and popularizers of electrical knowledge and interest than Jean A. Nollet (1700-70), of peasant ancestry from Noyon, whose mind and ambition made him a tutor and intimate of the Dauphin, a member of the French Academy of Sciences, a Fellow of the Royal Society, and professor of physics at Navarre and at Paris. Never ordained a priest, he assumed the title of Abbé and wore ecclesiastical garb to provide the acceptance and security of position at the French court. A friend of Musschenbroek and Dufay, Nollet travelled to England and Holland in 1734 with the latter, who had impressed his own charm and talents on the ambitious and popular physicist and lecturer. In addition to publicizing the discovery by Musschenbroek of the Leyden jar, Nollet, through the issue of over 40 published books and papers on electricity and kindred subjects, made experimentation with electric machines popular at the court, in the parlor, and in the lecture rooms of the academies.

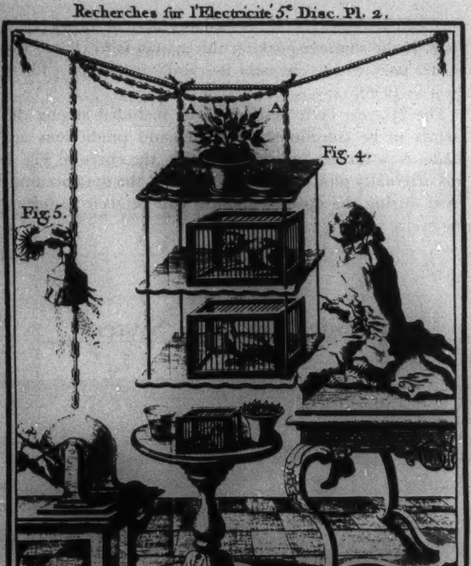
Recherches ſur l'Electricité 5.e Disc. Pl. 2.
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Fig. 4.
Fig. 5.

Fig. 1. Nollet's electrical experiments on animals and vegetables.

Before a French king and a gay court at Versailles in the mid-1700s, Nollet gave one of his most famous demonstrations of the unparalleled power of an electric discharge when he caused 180 soldiers of the royal guard, all holding hands in a wide circle, suddenly and simultaneously to leap into the air before a laughing audience. This display was later repeated in Paris by arranging a line of 700 Carthusian monks and causing them all to spring into the air on being shocked.

Nollet found that in addition to water as a receiver in a Leyden jar, other liquids served equally well, including mercury, and that even powders or iron filings would do. He tested the effects of electricity on animals and vegetables. Nollet's electrical experiments on animals and vegetables are shown in Fig. 1. The generator, lower left, electrified the silk-supported chain toward which water from the fountain, left, jetted rapidly, but only trickled from the spouts away from the chain. In one experiment he planted mustard seeds in separate receptacles and kept one such under electric charge for eight days. He noted that the electrified plants grew more than four times as fast as the others, although less hardy. For animal effect, two cats, each four months old, were selected, and one was kept near an electrical machine and was given electric treatments. The electrified cat lost more weight than the other, although Nollet was not completely certain of the cause–effect relationship. The experiments were extended to small birds, to pigeons, and to humans, with consistent loss of weight. He then tried to administer electric treatment to paralytic and sick patients with no positive results.

BENJAMIN FRANKLIN

THE INTEREST of the Philadelphia printer–philosopher in electricity was first aroused during a visit by Benjamin Franklin (1706-90) to Boston in 1744, where he listened to a lecture and demonstration by a Dr. Spencer, from England, one of several such traveling lecturers. Next, there arrived in Philadelphia, from England, a glass tube about two feet long and one inch in diameter which,

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Partial text of "Early Electrical Machines," published by the Burndy Library.

Bern Dibner is president, Burndy Corporation, Norwalk, Conn.

when dried, warmed, and rubbed, caused electrical displays. Along with the tube, a London Quaker and cloth manufacturer, Peter Collinson, had sent some of the published electrical studies by William Watson. From these Franklin derived information on the electrical progress abroad. He repeated the experiments, added new ones, and in all became completely absorbed in his electrical studies. In July 1747, Franklin wrote Collinson, transmitting his first contribution in the new electrical art—the effectiveness of pointed bodies "in drawing off and throwing off the electrical fire." Earlier experiments had, of course, used and shown pointed ends of electric apparatus but Franklin demonstrated how he could draw off a charge from a cannon ball to a pointed rod but could not reverse the process.

Franklin purchased the electric apparatus that Spencer had used in his lecture and with it continued electrical experimentation. Peter Collinson (1694-1768), for 30 years the general agent (without pay) of the Library Company of Philadelphia, more than any other man influenced Franklin in his scientific career. Things happened quickly in Franklin's electrical progress in the formative years of 1746-49. With the simple equipment acquired from Collinson in 1745, and from Spencer in the following year, Franklin quickly caught up with, and surpassed, the level of electrical understanding of his European contemporaries. He thereupon decided to retire from his lucrative printing business and devote himself to his scientific interests. With the glass tube and the instructions for using it that Collinson had presented to Franklin and his associates in the Library Company, Franklin filled his day and his house with the practice and demonstration of his electrical experiments. Franklin had replicas of the electric tubes blown by local glassmakers and these were augmented by further gifts from Thomas Penn, Proprietor of Pennsylvania. Although it was not clear in the description of Penn's gift as to the kind of apparatus it might well have been a rotary globe of the type independently contrived by Philip Syng, one of Franklin's fellow experimenters. In the period after Hauksbee, the tube, rather than the rotary sphere, was more commonly used, probably because it was simpler, lighter, and cheaper to acquire.

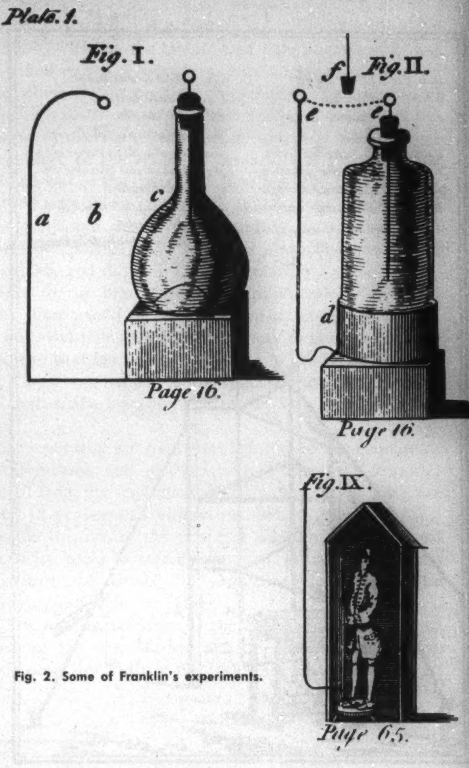

Fig. 2. Some of Franklin's experiments.

Franklin next turned to experiment with the Leyden jar. It was with this that his earlier notions of a "negative" state of electricity took firmer form in his mind. He determined experimentally that the charge "resided" in the glass of the jar and not in the outer foil or inner liquid of the jar. He termed the state of electrical charge on the outside of the jar, positive, and that on the inside, negative, and decided that rubbing simply caused the transfer of the electric charge from one surface to the other, the gain and the loss being of exactly equal quantity. He demonstrated this contention, illustrated in Fig. 2 (*Plate I-Fig. II*) by attaching a wire (e) to the outer coating (d) of a jar, and passing another wire (e) through the cork and into the water on the inside. Between the terminals of these wires Franklin suspended a cork ball (f) by a silk thread. He then placed the jar on a cake of wax to prevent leakage of the charge to the table or the floor. On electrifying the jar, the cork would oscillate from one terminal to the other, "fetching fire" from the inside to the outside until the equilibrium was restored and the cork ball hung limp between the wires. The operation of this arrangement of parts was similar to the "electric bell" of Andrew Gordon. The idea was recommended later, in 1752, by John Canton to attach such bells to Franklin's lightning rods to report the charge on the rod by lightning. With this device Franklin lengthened what had been until then an instantaneous spark or shock into an extended manifestation requiring some time. Also in Fig. 2 (*Plate I-Fig. IX*) Franklin's "sentry box" experiment is illustrated. A rod 30 feet tall, having a sharp point on top, and the bottom terminated in a stand within the shelter is placed on top of a high tower. A man on the stand might then draw sparks from the rod with a loop of wire held by a wax handle.

This then was an important way-station between the spark of the Leyden jar, or generator, and the continuous current of the voltaic pile. To the "parallel" arrangement of jars by Winkler and Watson, Franklin added the "series" arrangement of jars, which he described as "one hanging on the tail of the other."

With his one-fluid explanation, Franklin advocated a

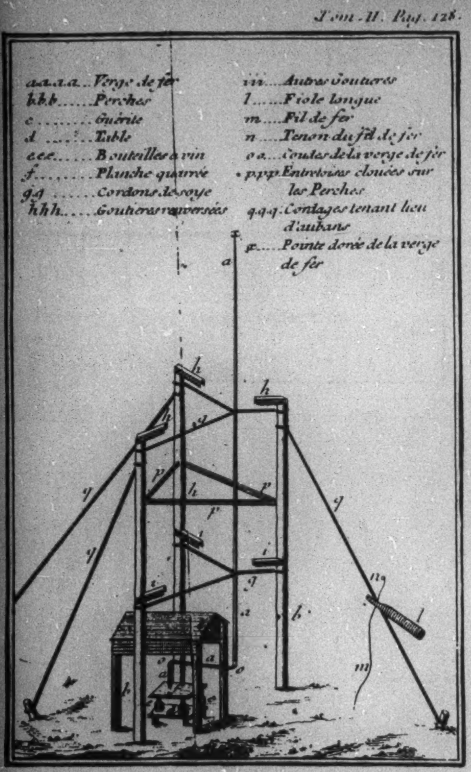
Tom. II. Pag. 128.
a.a.a.a.a...Verge de fer
b.b.b......Perches
c.........Guérite
d ....Table
e.e.e......Bouteilles à vin
f..........Planche quarrée
g.g ......Cordons de soye
h.h.h.....Goutieres renversées
i.i.i....Autres Goutieres
l......Fiole longue
m....Fil de fer
n....Tenon du fil de fer
o.o...Coudes de la verge de fer
p.p.p.Entretoises clouées sur les Perches
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Fig. 3. First attempt to prove Franklin's theory of the identity of electricity and lightning.

theory of the electric force as an imbalance of an otherwise normally neutral state. A positive charge corresponded to the "vitreous" electric fluid of Dufay, a negative charge to the "resinous" fluid. Thus, Franklin proposed two conditions of a single fluid to replace a system of two different fluids. Electricity was really "vitreous" electricity and positive, its absence or depletion was "resinous" and negative. Dufay's simplified terminology had to be modified when it was shown by Canton that resinous bodies may develop vitreous electricity and vitreous bodies, resinous electricity, if rubbed by suitable materials. Franklin's practice of designating vitreous electricity as positive and resinous as negative therefore superseded the Dufay designations. Canton in 1754 showed how he could generate charges of opposite sign on the two opposite ends of the same tube by using different excitants. Franklin evolved the one-fluid concept of electrical state without knowledge of Dufay's terminology. He also proposed the simpler and more meaningful terms "conductor" and "non-conductor" to replace the older "electric per se" and "non-electric." William Watson, in 1748, made public Franklin's one-fluid theory in a book by quoting an excerpt, covering three pages, from a letter by Franklin to Collinson dated June 1, 1747.

Franklin's curiosity about the work on electricity being done in Europe prompted him to ask for books on this subject from Collinson in London and Musschenbroek in Leyden. It seemed the more he read, the less original work he accomplished. After 1752, his active mind began gradually turning to other interests but by then he had already made contributions of prime importance to the understanding of the new science. He explained the operation of the condenser in the Leyden jar forms as a "Franklin pane," or parallel plate condenser. Bevis, at about the same time as Franklin, also had coated both sides of a thin plate of glass about a foot square with silver foil, and in comparing its electric capacity to that of a Leyden jar, rated it as equal to one of a half-pint size. Franklin assembled a "battery" of 11 such large plates of window glass sandwiched between thin lead plates and connected alternate lead plates together by two long wires. By 1755 he had electrified a silver can and observed that a cork ball lowered into it by a silk string was not attracted to the inner walls, but could offer no explanation of this strange behavior. A few years later, he knew that the charge remained only on the outer surface of a rounded body. Franklin held that atmospheric electricity was caused by evaporation, that clouds were usually negatively charged, positively charged clouds being of rare occurrence.

The international fame of Franklin's scientific achievement followed his formulating the hypothesis that lightning was an electrical display. First mentioned by Franklin in 1749 in one of a series of letters to English scientists and gathered and published two years later in London, the identity of lightning and electricity became the subject of considerable discussion, communication and experimentation, culminating in the famous kite experiment in June 1752.

To Dalibard, botanist, physicist, and teacher of Buffon, goes the distinction of having erected a lightning rod 40 feet high in May 1752 at Marly, 18 miles from Paris. This rod was one-inch diameter iron and was supported by silk cords fastened to stakes. The rod terminated in an L at its lower end and this rested on a table in a protected wooden enclosure (Fig. 3). Its successful action was reported to the Academy at Paris three days later. "On the tenth of May, 20 minutes past two in the afternoon, a stormy cloud having passed over the place where the bar stood, those that were appointed to observe it drew near, and attracted from it sparks of fire, perceiving the same kind of commotions as in the common electrical Experiments."

An old soldier named Coiffer, left on duty at the shelter while Dalibard was in Paris, was the one who actually drew sparks from the rod during a storm. The spark was described by him and by the local priest Raulet, who hurried to witness the experiment, as of a bluish color and sulfurous smell, about 1½ inches long.

Franklin acknowledged his thanks to Dalibard in writing to him of electricity "that Branch of Philosophy, which is already so greatly indebted to you, as being the first of Mankind that had the Courage to attempt draining Lightning from the Clouds to be subjected to your Experiments."

The similarity in the appearance, sound, speed, and violence of an electric spark produced in the laboratory to the flash of lightning and following clap of thunder made its impression on many experimenters. Dr. William Wall published a letter in 1708 in which he related that on seeing the sparks and hearing the crackles of the electric discharge from a glass globe or large piece of amber, "it seems, in some degree, to represent Thunder and Lightning." This relationship was touched on by Newton in 1716 and 30 years later by Gray and Dufay. In 1748 John Freke in London, Nollet in France, and Winkler in Germany elaborated on the similarity of lightning and electricity. All remained within the area of speculation, none *demonstrated* the identity.

Franklin, in 1749, wrote, " say, if these things are so, may not the knowledge of this power of points be of use to mankind, in preserving houses, churches, ships, etc., from the stroke of lightning, by directing us to fix on the highest parts of those edifices, upright rods of iron made sharp as a needle, and gilt to prevent rusting, and from the foot of those rods a wire down the outside of the building into the ground, or down round one of the shrouds of a ship, and down her side till it reaches the water? Would not these pointed rods probably draw the electrical fire silently out of a cloud before it came nigh enough to strike, and thereby secure us from that most sudden and terrible mischief? . . . To determine the question, whether the clouds that contain lightning are electrified or not, I would propose an experiment to be tried where it may be done conveniently. On the top of some high tower or steeple, place a kind of sentry-box big enough to contain a man and an electrical stand. From the middle of the stand let an iron rod rise and pass bending out of the door, and then upright 20 or 30 feet, pointed very sharp at the end. If the electrical stand be kept clean and dry, a man standing on it when such clouds are passing low, might be electrified and afford sparks, the rod drawing fire to him from a cloud. If any danger to the man should be apprehended (though I think there would be none) let him stand on the floor of his box, and now and then bring near to the rod the loop of a wire that has one end fastened to the leads, he holding it by a wax handle; so the sparks, if the rod is electrified, will strike from the rod to the wire, and not affect him."

In recounting the steps that led him to the conclusion that lightning and electricity were identical, Franklin quoted from the scientific journal he kept (now lost). He listed 12 properties common to both, then as regards a possible thirteenth, the property of both lightning and electricity being attracted by points, he added, "Let the experiment be made." The experiments *were* made by Dalibard and Delor at Marly.

(The next installment of the article will carry an account of the Van Marum machine, the largest electrostatic generator built in the 18th Century.)

High-Speed Facsimile System

The unveiling of its newest facsimile set, the fastest known means of flashing a photograph from one spot to another, was announced by the Department of the Army.

Developed by the U. S. Army Signal Engineering Laboratories located at Fort Monmouth, N. J., the new portable radio facsimile system can put a high-quality photo in the hands of a person miles away—five minutes after the photographer clicks the shutter.

The set can flash vital military reconnaissance pictures by radio to command headquarters in time to affect a critical decision and perhaps change the course of a battle. Its record speed could also revolutionize photo reporting by daily newspapers.

This facsimile equipment fits easily into the back of a radio-equipped jeep or car and can send a picture to its companion receiver 40 miles away. The set can also send a photo thousands of miles, over standard telephone lines or around the world, by long-range radio circuits.

The new facsimile, the fastest in the world, combines high-speed Army picture-sending techniques with a polaroid film that produces a finished print one minute after exposure. No darkrooms or messengers are needed.

The first field model of the new portable radio facsimile system was built under Army Signal Corps sponsorship by the Times Facsimile Corporation, New York, N. Y.

A Resistance Temperature Detector for Reactors

F. R. SIAS
MEMBER AIEE

IN A HEAT POWER PLANT, temperature is a major parameter. The accuracy with which it can be measured determines whether the plant can work efficiently, close to the upper boundaries of mechanical strength and close to critical pressures, or whether performance must be sacrificed by leaving wide safety margins. For this reason, and also because of its large power output and lack of cold junction compensation problems, a resistance thermometer is preferable for use in nuclear reactor applications, such as in atomic-powered submarines.

Specifications included an upper working pressure and temperature of 3,184 pounds per square inch and 705 F, a flow rate of 45 feet per second, a response time of 1.0 second, a desired life of 40,000 hours, and an ambient air temperature of 70 C. It must also withstand a radiation field of 1×10^5 neutrons per square centimeter per second fast neutrons, 5×10^5 neutrons per square centimeter per second slow neutrons, and gamma radiation of 200 roentgens per hour. It must be capable of withstanding U. S. Navy "hi-shock" and vibration tests, and it must also be mechanically strong enough for use as a step by maintenance personnel.

There are conflicting design requirements for a resistance temperature detector sensing element. Fast response demands low thermal mass and good thermal conductivity, while strength calls for thick protecting walls. Soft wire must be mounted in order to be strainfree for good electrical stability, with resultant poor thermal conductivity.

Tungsten wire has been shown[1] to have good electrical stability, and adjustment of temperature coefficient and resistance can be made on the finished bulb. It is also strong enough to stand mechanical strain without permanent loss of resistance characteristics. In addition, it must be stable under a radiation field. Nine tungsten units exposed to the equivalent of the radiation field required showed no significant change in resistance.

Fast response requires very close contact between the sensing winding and the medium whose temperature is to be measured. The winding is placed on notched mica cards, and leads are attached. Mica sheets are placed on either side to form a sandwich which is slipped into a flattened stainless-steel tube, and the whole is bent in a die to form a U shape. This operation stretches the tube into very close contact with the winding. It is then brazed into the mounting block with gold–nickel alloy and the space around the leads is packed with alumina powder.

If the sensing windings were made of soft metal, this forming process would distort the wire and change its resistance adjustment. With tungsten, no large change in resistance occurs and, since the resistance adjustment is made on the completed element,[1] there is no problem. Tungsten also has the advantage of giving a linear voltage output vs temperature curve from a fixed bridge over the desired temperature range.

The mounting block is machined for two sensing elements, thus allowing two separate measurements or a spare, with a single penetration of the high pressure piping. This penetration is made by welding a boss to the piping. The resistance thermometer is screwed into the boss, the thread being lined with a helicoil insert, and then the flange is welded to a similar flange on the boss. This weld is made to prevent leakage, and the thread provides the strength to withstand internal pressure.

The leads are brought out through high-temperature hermetic seals, and tubulations are provided through which alumina powder and helium, slightly above atmospheric pressure, are introduced. A waterproof head which contains a terminal board can be rotated and clamped in any direction to facilitate conduit installations.

Response time tests were made by applying a step change of temperature to water flowing at a known velocity. At 30 feet per second, response time was 0.4 second (63% change). Self heat at 15 feet per second flow and 1 watt dissipated in the detector was 1.7 F; and 0.2 F at 0.1 watt.

The various components of the device have been pressure tested separately, the sensing element itself to 5,500 pounds per square inch with no significant changes in resistance either permanent or temporary. The minimum failure point of the hermetic seals was 7,000 pounds per square inch, while the seal weld and helicoil thread withstood pressures greater than 8,500 pounds per square inch.

Thus, a resistance-type temperature detector has been designed which will more than fulfill the requirements for operation in an atomic-powered submarine. Under normal flow conditions, it has very fast response and high power-dissipating capacity. It can be adjusted to high precision and will maintain that adjustment for long periods of time in an atomic radiation field. It has withstood pressure testing far above its operating range and is sufficiently rugged to withstand severe shock and vibration.

REFERENCE

1. A Tungsten Resistance Thermometer, F. R. Sias, J. R. Macintyre, A. Hansen, Jr. AIEE *Transactions*, vol. 73, pt. I, 1954, pp. 66-69.

Digest of paper 57-901, "A Resistance Temperature Detector for Nuclear Service," recommended by the AIEE Committee on Nucleonic and Radiation Instruments and approved by the AIEE Technical Operations Department for presentation at the 2nd Nuclear Science and Engineering Conference, Philadelphia, Pa., Mar. 11-14, 1957. Scheduled for publication in AIEE *Communication and Electronics*, July 1957.

F. R. Sias is with the General Electric Company, West Lynn, Mass.

INSTITUTE ACTIVITIES

Outstanding Program Planned for AIEE Pacific General Meeting

THE AIEE Pacific General Meeting will be held in Pasco, Wash., August 28–30, 1957. The headquarters for the meeting and all technical sessions held will be in the new Pasco Senior High School.

The technical program will be notable for the variety of subject matter as well as the quality of the papers. The social and recreational programs have been planned for the engineer and his family, and will be mostly outdoors. The inspection trips will be both traditional and precedent setting with a strong emphasis on variety to suit a wide field of interests.

The guests will find convenient parking close to meeting headquarters, hotels, and motels. The family groups will find the outdoor recreational activities and the semiarid climate very attractive.

The famous Ellensburg Rodeo will be held Labor Day week end and many county fairs and other events prior to and following the AIEE Pacific General Meeting will be of extraordinary interest to family groups. A trip through the apple and other fruit orchards as well as the endless variety of vegetable growing and packing plants of the Inland Empire sections of eastern Oregon and Washington will be an unforgettable experience. The snow capped Rockies to the east and the Cascades to the west provide recreational and camping opportunities and scenery unmatched in beauty and variety. The almost complete absence of rain during August and September adds tremendously to the pleasure of the outdoors. Traveling along the well-marked trails and excellent highways located to provide the most favorable approaches and maximum accessibility will long remain a memorable experience.

General Session

The General Session on Wednesday morning, August 28, will include an address by President W. J. Barrett. It will also feature speakers of national reputation in the fields of atomic power. F. J. McCune, vice-president and general manager of the Atomic Products Division of the General Electric Company and AIEE Fellow will discuss "Outstanding Problems in the Atomic Energy Field." Plans include another speaker of prominence who will cover other important phases of the atomic energy industry.

Hotel Reservations

A large number of rooms in hotels and motels located in Kennewick, Pasco, and Richland are available. These rooms will be reserved until the first day of the meeting.

Hotel and motel charges will be: single—$5 to $6, double—$5 to $8, and twin—$7 to $10.

There are rooms available with a double and single bed and also with two double beds. Persons wanting such special arrangements should state their needs in the request for reservations.

Persons planning to attend are urged to write AIEE Pacific General Meeting, Pasco, Wash., and express their preferences for type of room and facility.

Lunch Facilities

The several luncheons described at other places will be supplemented by a lunch service in the headquarters building. The prices will be a matter of individual choice.

Registration

The registration activities will be located in the Pasco Senior High School and will open Tuesday noon and will be open daily thereafter until Friday evening. Fees for all activities will be collected there.

All mail for persons attending or inquiries concerning the meeting should be addressed to AIEE Pacific General Meeting, Pasco, Wash., and marked attention of the appropriate person or activity.

Advanced Registration

All persons are urged to return their advanced registration cards promptly. The registration fees will be $3 for members and $5 for nonmembers. Student members and families of members will not be required to pay a fee.

Transportation

West Coast Airlines (WCA) has several flights each day between Northwest, United, and Western Airlines terminals and Pasco. The WCA schedules are convenient and provide the best connections at transfer points in Spokane, Seattle, Portland, and Boise.

The most modern streamliner trains of the Great Northern, Northern Pacific, and Union Pacific Railways are routed through or close to Pasco. The schedules will be found to be most convenient both as to arrival and also for departure from Pasco.

The Greyhound Bus system has frequent arrivals from and departures to all important West Coast cities. Many of the buses are express runs to distant points routed through matchless scenery and past important historical and industrial sites.

The Pasco area is the junction point for many of the more important highways in the Northwest. These highways radiate to the key cities of the Northwest and are relatively new.

Ladies Program

All visiting ladies will be guests at a brunch Wednesday morning at 10 a.m. in the patio of the Desert Inn in Richland. All persons planning to attend are urged to register in advance of Wednesday morning.

The Kennewick Country Club will welcome the ladies to a buffet supper Wednesday evening at 6:30 p.m. The supper

AN INSPECTION TRIP to the Midway Substation will be held August 30 during the Pacific General Meeting. The Midway Substation is the hub of the Bonneville Power Administration main transmission grid, interconnecting Grand Coulee, Bonneville, and The Dalles Dams and the central Washington load areas.

will be followed by a Bingo Party. Tickets will be $2.75.

The Officers Club in North Richland will be the location for luncheon on Thursday at 12:45 p.m. Bridge and Canasta will follow the luncheon. Tickets for the event will be $1.75.

Ladies are cordially invited to play golf at any time at the Kennewick Country Club. It is suggested that ladies who are not interested in inspection trips may find golf and swimming at the Kennewick Country Club to be a very pleasant morning activity.

The Tri-Cities have many park areas and facilities which are ideally suited for family picnicking, swimming, tennis, and recreational activities. Riding horses are generally available.

The weather in the Tri-Cities will probably be warm. Clothes and shoes should be cool and comfortable. Sun dresses with jackets are especially good and a sweater or stole should be included for the cool evenings.

Entertainment Program

The evening entertainment programs have been planned so that sport or western clothes will be in order.

A Stag Smoker will be held Wednesday evening in the spacious Elks Club in Pasco. The club facilities and activities will be available and the costs will be a matter of individual choice. A buffet dinner will start at 7 p.m. and tickets will be $2.50 each.

Sacajawea State Park will be the scene for the Thursday evening activities. There will be plenty of real western barbecue with all the trimmings. The Snake River Cowboys will be on hand to keep things moving. Several water sports activities will also be presented. The entire affair at Sacajawea Park will be covered by the $2 tickets.

Following the activities at Sacajawea State Park, the facilities of the Pasco Elks Club will be available for dancing and club activities for those who do not have other plans.

Student Program

Informal gatherings Wednesday will help the students of Districts No. 8 and No. 9 get acquainted and meet the students from other Districts.

The Student Luncheon Thursday noon will provide further opportunities to get acquainted. The students will be guests and all members are invited to attend. Pres. W. J. Barrett has been invited to discuss student problems and interests.

The Thursday afternoon meeting for students will feature presentation of two top ranking District contest papers and will include a discussion of student branch affairs.

The Faculty Counselors Meeting also will be held Thursday afternoon.

The student programs have been arranged to permit student participation in the many interesting inspection trips and technical programs. The entertainment and ladies programs have been planned to offer many items of interest to students.

Inspection Trips

Several interesting inspection trips have been planned for the meeting. These include tours of the McNary Dam and Powerhouse on the Columbia River, the Ice Harbor Dam construction on the Snake River, and the 230-kv Midway Substation.

Members registering for the Pacific General Meeting are also asked to register in advance for these trips because the number of persons who can be accommodated on each trip is limited. In making trip reservations, members should furnish names, nationalities, and business connections. Fees will be collected at the Registration Desk when tickets are picked up at the meeting headquarters.

Proof of United States citizenship will be required for the McNary Powerhouse and Midway Substation trips, and members should be prepared to comply with security regulations such as are in effect at the time of the meeting.

McNary Dam and Powerhouse (Thursday, August 29, 8 a.m. to 12 Noon). A 42-mile trip by chartered buses will be made to one of the great hydroelectric installations of the Northwest located on the Columbia River at Umatilla, Oreg. Outstanding features include the powerhouse 1,422 feet in length with 980-mw installed capacity, the spillway for 1,368,000 cubic feet per second at normal pool, the 92-foot single lift navigation lock and fish ladders for salmon migration to the headwaters of the Columbia and Snake Rivers. Ticket: $2.50.

Ice Harbor Dam Construction and Phillips Pacific Chemical Company Plant (Thursday, August 29, 3 p.m. to 5 p.m.) Visitors will have a choice of two short inspection trips: (1) six miles from Pasco, to see the early stages of Ice Harbor Dam construction, a hydroelectric dam and powerhouse which will eventually rival other large installations in the Northwest power system; (2) nine miles from Pasco, to see a chemical plant installation for the manufacture of anhydrous ammonia which was completed in Spring 1957. Ticket: $1 each trip.

Midway Substation and Hanford Works Area Tour (Friday, August 30, 8 a.m. to 2 p.m.) A trip by chartered buses to the Midway Substation. The buses will travel through the Hanford Works barricaded area giving an opportunity to see these important Atomic Energy Commission installations. Groups will stay aboard the buses; however, stops will be made at various reactors and chemical separations areas to enable guides to discuss process steps.

The Midway Substation is the hub of the Bonneville Power Administration main transmission grid, interconnecting Grand Coulee, Bonneville, and The Dalles Dams and the central Washington load areas. Because of Midway's strategic location and the number of interconnections, involving nearly a million kilowatts, it is extremely important from a system stability standpoint.

Lunch will be served at Midway. Buses returning to Pasco will again pass through the Hanford area, but by a different route from that of the outgoing trip. Ticket: $5.

We suggest that members traveling to this Pacific General Meeting by private automobile may well combine it with a pleasant vacation trip and use the opportunity to visit other important Pacific Northwest developments, such as the Grand Coulee and The Dalles Dams on the Columbia River and the Kaiser Aluminum Plant near Spokane, Wash.

Committee

The Pacific General Meeting committee chairmen are: O. W. Hurd, general chairman; H. A. Carlberg, vice-chairman; S. M. Rhyneer, secretary; W. J. Dowis, technical program, H. A. Broderson, transportation and inspection trips; D. W. McLenegan, students, Mrs. C. R. Bergdahl, ladies; R. B. Britton, entertainment; L. P. Reinig, registration; F. P. Robinson, hotels and motels; F. J. Mollerus, finance; and R. C. Hoffman, publicity.

Walla Walla District, Corps of Engineers

POWERHOUSE AT McNARY DAM with 14 generators installed will be viewed during a Pacific General Meeting inspection trip to one of the great hydroelectric installations of the Northwest.

Pacific General Meeting, Pasco, Wash., August 28-30, 1957

Tentative Technical Program

Wednesday, August 28

Afternoon Sessions

Power Generation

Presiding: R. L. Earnhart

CP.* Friction and Windage Loss Tests of McNary Generators with Coupled and Uncoupled Turbine. *D. R. Cox, R. L. Krahn,* U. S. Army Corps of Engineers

CP57-904. Transient Performance and Excitation Systems. *R. L. Krahn,* U. S. Army Corps of Engineers

CP.* Planning and Design Considerations for Ice Harbor Powerhouse. *G. H. Von Gunten, J. R. Kline,* U. S. Army Corps of Engineers

CP57-905. Gas Turbines Applied to Power Generation. *K. L. Rieke, W. N. Hornberger,* Westinghouse Electric Corporation

CP.* Large Gas Turbines for the British Columbia Power Commission. *A. O. White,* General Electric Company

Nucleonic and Radiation Instruments

Presiding: L. H. Holthausen, M. M. Dye

CP.* A Reactor Rod Control System for Pressurized Water Reactors. *G. S. Keeley, W. J. O'Bryant,* Westinghouse Electric Corporation

CP.* A Nuclear Instrumentation System for Pressurized Water Reactors. *W. J. O'Bryant, G. S. Keeley,* Westinghouse Electric Corporation

CP.* Experimental Determination of Reactor Control System Transfer Functions. *G. St. Ledger Barter,* General Electric Company

CP.* Characteristics of Pressurized Water Reactor Plant Dynamic Pressure Measuring Systems. *E. J. Brooks,* Westinghouse Electric Corporation

57-906. Safety Systems for Nuclear Power Reactors. *I. M. Jacobs,* General Electric Company

Human Engineering

Presiding: D. W. McLenegan

CP.* (Title to be selected) *Dr. G. F. Kennard,* International Business Machines Corporation

CP.* Assistance to Engineers from Human Factors Research. *Dr. Maurice Rappaport,* Stanford Research Institute

CP.* Advanced Instrumentation. *Dr. Jesse Orlansky,* Dunlap and Associates

CP.* Remote Handling and Manipulation of Hot Cells. *Dr. J. W. Wissel,* Lockheed Aircraft Corporation

CP.* Human Factors in Maintenance of Electronic Systems. *Dr. N. D. Warren,* University of Southern California

Wire Communication

Presiding: S. J. McDermott

CP57-930. Applying Carrier to Existing Plant, Northern California Telephone Company. *E. M. Calderwood,* retired; *G. A. Furniss, I. J. Robertson,* Pacific Telephone and Telegraph

CP57-907. A Transistorized Repeater for Use with the *45BN* Cable Carrier System. *V. Babin, R. H. Fish,* Lenkurt Electric Company

CP57-908. Application of 8-Kv Neutralizing Transformers. *A. W. Adams,* Bonneville Power Administration; *R. E. Kistler,* Pacific Telephone and Telegraph; *T. W. MacLean,* Washington Water Power

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CP.* United States to Alaska Cable. *C. A. Bartlett,* American Telephone and Telegraph; *T. H. Stewart,* Alaska Communication System, U. S. Army

Thursday, August 29

Morning Sessions

Transmission and Distribution

Presiding: E. C. Starr

CP57-909. 230-Kv Wood Pole Line Spokane to Lewiston. *Earl Baughn,* Washington Water Power Company

CP57-910. Simplified Sag Calculations for Power Transmission Lines. *F. J. Hubert*

CP57-911. Surge Protection of Cable-Connected Power Transformers at Skattergood Steam Plant. *C. M. Short,* Water and Power Department, City of Los Angeles; *T. J. Bliss,* Westinghouse Electric Corporation; *M. K. Enns*

CP.* Effect of Flat Rate on Electric Power Consumption. *F. J. Mollerus*

57-912. The Digital Computer and Power System Short Circuit Calculations. *M. J. Lantz,* Bonneville Power Administration

Nucleonics I

Presiding: J. V. Kresser

57-396. Some Operational Problems of the Nuclear Power Plant. *R. W. Witzke, A. R. Jones,* Westinghouse Electric Corporation

CP.* Operating Hanford Reactors. *D. S. Lewis,* General Electric Company

CP.* Training Operating Personnel for Nuclear Power Plants. *W. G. McKeown,* Westinghouse Electric Corporation

CP.* A Method of Evaluating Reactor Hazards. *A. B. Carson, K. W. Hess, L. H. McEwen,* General Electric Company

Industrial Power Systems I

Presiding: R. A. Erwin

CP57-926. Matching Power Systems to Industrial Safety Standards in the Pulp and Paper Industry. *H. E. Springer,* Rayonier, Incorporated

CP57-913. Electric Safety in the Cannery. *R. S. Wilson,* consulting electrical engineer

CP.* Machine Grounding Practices. *C. W. Cutler,* consulting engineer

CP.* Power Supplies for an Operating Reactor. *L. P. Reinig,* General Electric Company

Radio Communication

Presiding: T. W. Stringfield

CP.* Pocket Carried Radio Systems. *John Mitchell,* Portable Products

CP.* Modifying Transmitters for Single Sideband Operations. *Norman Young,* Federal Telecommunication Laboratories

COFFERDAM AT ICE HARBOR will be visited by those taking an inspection trip to see the early stages of Ice Harbor Dam construction on August 29 during the Pacific General Meeting.

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* Conference Papers will not be printed by the Institute; however, they may be available at the meeting at the discretion of the author.

CP57-914. Willamette Valley Radio System for the U. S. Corps of Engineers. *C. Pederson,* U. S. Army Corps of Engineers; *D. J. Marihart,* Bonneville Power Administration

57-915. Microwave Radio Communication under Heavy Ice, Sleet, and Snow Conditions on the BPA System. *Emory Strong, E. J. Warchol,* Bonneville Power Administration; *Stanley Benson,* Philco Corporation

Afternoon Sessions

Substations

Presiding: A. A. Straub

CP.* Fire Protection and Minimizing Fire Hazards in Substations. Report of Working Group 54.2. *F. J. Maas,* Bonneville Power Administration

CP57-916. High Voltage–High Capacity Interrupting Test Facilities of Southern California Edison Company. *E. E. Tugby,* Southern California Edison Company

CP57-917. Application of Pole-Mounted Capacitors to a Primary Network Distribution System. *C. F. Bannon, L. L. Gleason,* Seattle City Light

Nucleonics II

Presiding: W. J. Dowis

57-404. Electrical Problems in Electrical Burnout Testing of Nuclear Fuel Elements. *T. W. Hunt,* Westinghouse Electric Corporation

CP57-684. Analog Computer Study of the Transient Performance of a Dual Cycle Boiling Water Reactor Nuclear Power Plant. *D. W. Leiby,* General Electric Company

CP.* A Cockroft–Walton Multiplier Design Study. *R. N. Edwards, G. Jernakoff,* General Electric Company

CP.* Optimizing Reactor Design on a Digital Computer. *J. O. Orton,* General Electric Company

CP.* Design of a Radially Symmetrical Heat Transfer Analogue. *D. E. Sebade,* General Electric Company

Conference on Industrial Power Rectifiers

Presiding: Waldo Porter

A conference on safety, maintenance and operation of power rectifier stations, with speakers from several rectifier using plants in western states.

Television and Aural Broadcasting

Presiding: E. D. Barcus

57-918. A Modified Microwave System for Color Television Transmission. *F. F. McClatchie,* Pacific Telephone and Telegraph Company

57-919. A Video Differential Phase and Gain Equalizer. *J. H. Clark,* Pacific Telephone and Telegraph Company

57-723. Statistical Encoding for Text and Picture Communication. *W. S. Michel,* Bell Telephone Laboratories (For Discussion)

CP.* A New Automatic Frequency Control Circuit. *L. B. Bennett,* Pacific Telephone and Telegraph Company

Friday, August 30

Morning Sessions

Space Heating and Air Pollution (Joint Session)

Presiding: R. G. Scott

CP.* Electric Greenhouse Heating. *J. A. MacCarthy,* B-C Electric

CP.* A Simplified Control for Combined Electric Heating and Cooling Installations. *L. N. Roberson,* L. N. Roberson Company

CP.* Measurement of Air Contamination. *J. C. Beckett,* Wesix Corporation

Safety

Presiding: H. E. Vann

57-920. A Compendium of Grounding Techniques for Personnel and Equipment Protection. *H. E. Heddesheimer,* General Electric Company

CP.* Comparison of Safety and Performance Requirements for Nuclear and Conventional Power Plants. *A. F. Ariey,* Pacific Gas and Electric; *E. P. Peabody,* General Electric Company

CP.* Safety in Nuclear Power Plants. *S. Levy,* General Electric Company

Industrial Power Systems II

Presiding: W. Ferguson

CP.* Electric Power Requirements of Oil Refineries in Pacific Northwest. *J. T. Brannan,* Shell Oil Company

CP.* Design of Industrial Power Systems to Protect Motors from High Speed Reclosing of Supply Breakers. *F. Nolan, D. Dalasta,* Allis-Chalmers Manufacturing Company

CP.* Power Supply for the Hanford Atomic Plant. *Ralph Haynes,* General Electric Company

CP.* Fault Testing on the Power System of the Hanford Plant. *A. A. Maxwell,* General Electric Company

Afternoon Sessions

Magnetic Amplifiers

Presiding: A. B. Rosenstein

CP.* Analysis of Nonresonant Charging Circuit for Magnetic Pulse Generation. *N. L. Weinberg,* Westinghouse Electric Corporation

CP57-921. Core Reset Functions—Magnetic Amplifier Analysis, Part II. Determination of Amplifier Performance. *G. C. Feth,* General Electric Company

CP57-922. Magnetic Amplifier Design—Part I, The Core. *R. E. Anderson,* General Electric Company

CP57-923. The Block-Diagram Method of Analysis Applied to the Saturable Reactor. *R. M. Hubbard*

Flight Test Instrumentation

Presiding: W. S. Pritchett

CP.* Transistorized Airborne Data Acquisition System. *A. I. Morrison,* Electrical Engineering Company of California

CP.* Surface Temperature Measurement in Flight Test Instrumentation. *A. E. Davis,* Boeing Airplane Corporation

CP.* Magnetic Recording of Flight Test Data. *R. M. Strassner,* Ampex Corporation

CP57-928. A Miniaturized Instrumentation Converter System for Aircraft Flight Testing. *H. E. Hommes,* McDonnell Aircraft Corporation

CP57-924. Improved Static Defect Calibration System. *B. J. Heilweck,* McDonnell Aircraft Corporation

Relaying

Presiding: M. A. Bostwick

CP57-927. Improved Protection for Industrial and Commercial Loads with Emphasis on Conductor with the Utilities Protection. *M. A. Bostwick,* Portland General Electric Company

CP.* Portable A-C Analyzer. *P. G. Moore,* General Electric Company

57-796. Digital Short Circuit Solution of Power System Networks Including Mutual Impedance. *M. J. Lanz,* Bonneville Power Administration

Many Engineers Attend Rectifiers in Industry Conference

On June 4-5, some 293 engineers from all sections of the United States and Canada and from as far away as Great Britain gathered in Chicago, Ill., for a Conference on Rectifiers in Industry.

During the conference, 21 papers were presented by representatives of both the manufacturers and users of rectifier equipment. These papers covered a wide area including theory, standardization, application, operation, and maintenance. Rectifiers of the mercury arc, mechanical, semiconductor, and metallic types were discussed.

The conference was sponsored jointly by the Industrial Power Rectifier Committee, the Semiconductor Metallic Rectifier Committee and the Chicago section of AIEE. This was the second of a series of conferences devoted to rectifier equipment design, application, and operation. The previous conference was held in Pittsburgh, Pa., in 1952. At that time, main consideration was given to the mercury arc rectifier. At the Chicago conference, the relatively new semiconductor rectifier was recognized as one which will become a major influence in the power conversion field.

The papers presented covered the use of rectifiers to furnish direct current for such tasks as the reduction of aluminum, production of chlorine and other chemicals, as a power supply to main drives and auxiliaries in steel mills, for specialized power supply such as excitation for turbine generator and battery charger for automatic telephone switchboard, and many other applications where direct current is required.

The conference was opened by J. N. Banky, Chicago Section chairman, and immediately given perspective by presentations from Glen Ramsey and Marvin Morack who served as co-chairmen. Mr. Ramsey reviewed the history of semiconductor rectifying devices including electrolytic, copper sulfide, copper oxide, selenium, germanium, and silicon units. Mr. Morack reviewed the basic uses of d-c power in industry and compared the various power converters available today with the thought of evaluating the various types from the users viewpoint.

Considerable interest was shown in a panel discussion on the general subject of uses of power rectifier equipment. This panel discussion was initiated by users from four prominent fields outlining briefly the manner in which rectifiers have been applied in their particular industry. D. E. Truckess of Bell Laboratories discussed rectifiers in the low voltage industrial field. R. Scott of Utilite Corporation discussed the use of rectifiers for low voltage plating application. C. A. Langlois of Reynolds Metals Company discussed the use of rectifiers in the high voltage electrochemical field. Joe Bodoh discussed the use of rectifiers in the steel industry. Subsequent to these brief presentations the discussion was presided over by G. N. Zins of the Westinghouse Electric Corporation and a panel including I. K. Dortort, G. W. Gutzwiller, and C. S. Hague in addition to aforementioned users attempted to answer questions raised by users in the audience. Much worthwhile information was interchanged in this discussion.

In addition to the presentations of Mr. Morack and Mr. Ramsey, the morning session of the first day included papers entitled "A Review of Semiconductor Rectifier Technology in Europe" by E. A. Harty, General Electric Company; "NEMA Standards for Semiconductor Rectifiers" by L. W. Burton, General Electric Company; "Mercury Arc Rectifier Standards" by Harold Winograd, Allis-Chalmers Company; and "IEC Semiconductor Standards and the Munich Meeting" by I. R. Smith of the Westinghouse Company.

The afternoon session of the first day was devoted largely to mercury arc type rectifiers with papers being presented under the subjects of "Application of New Designs of Ignitron Rectifiers," "Field Testing of the Sealed Ignitron," "The Mercury Arc Rectifier and the Hydrogen Ion," "Analysis of the Ignitron Rectifiers for Reversing Mill Drives," "A New Package Rectifier Design for Electrochemical Service," and "Design and Application of Excitron Rectifiers." All these papers presented new developments in available mercury arc rectifier equipment.

The second day of the conference was devoted largely to semiconductor rectifiers with papers given on several subjects such as "A 10-Kw Germanium Rectifier for Automatic Power Plants," "The Application of Selenium Rectifiers to Turbine Generator Excitation," "The Rating and Application of Silicon Power Rectifiers," "Silicon Power Rectifier Equipment," "A High Current Density Selenium Rectifier," "Selenium Rectifier Applications in Automotive Vehicles," and "Germanium Rectifier Equipment for Electrolytic Process." These papers covered the broad range of semiconductor rectifier equipment with ratings from a few amperes to ratings in several thousand amperes.

Guest speaker at the Tuesday luncheon meeting was Dr. W. A. Lewis, professor of electrical engineering at Illinois Institute of Technology and former dean of the Graduate School of Illinois Institute of Technology. His subject was "The Professional Development and Recognition of Engineers in the AIEE." Dr. Lewis gave a thought-provoking talk on the meaning of the terms "engineering" and "professional," and outlined some of the work that is now being undertaken to obtain for the engineer greater professional recognition.

The entire proceedings of the conference are published in a bound volume entitled "Rectifiers in Industry" identified by number *T-93*. These proceedings were available at the conference and now can be obtained from AIEE Headquarters, 33 W. 39 St., New York 18, N. Y., price $4.

The sponsors of this conference wish to express their sincere thanks to all the companies and persons who participated in arranging this conference and to those who presented papers.

Future AIEE Meetings

Pacific General Meeting*
Pasco, Wash.
August 28-30, 1957

AIEE Magnetic Amplifiers Conference*
Penn-Sheraton Hotel,
Pittsburgh, Pa.
September 4-6, 1957

Petroleum Conference*
Penn-Sheraton Hotel,
Philadelphia, Pa.
September 9-11, 1957

AIEE-IRE Industrial Electronics Symposium*
Morrison Hotel, Chicago, Ill.
September 24-25, 1957

AIEE-IRE-IIT-NU-U of I National Electronics Conference
Hotel Sherman, Chicago, Ill.
October 7-9, 1957
(Final date for †TP—Closed, ‡CP Syn.—Closed, CPMs—Aug. 1)

Fall General Meeting
Chicago, Ill.
October 7-11, 1957
(Final date for †TP—Closed, ‡CP Syn.—Closed, CPMs—Aug. 2)

Reliability and Quality Control in Electronics Conference
Silver Spring, Md.
October 10, 1957
(Final date for †TP—Closed, ‡CP Syn.—Closed, CPMs—Aug. 2)

Feedback Control Conference
Chalfonte-Haddon Hall Hotel
Atlantic City, N. J.
October 16-18, 1957
(Final date for †TP—Closed, ‡CP Syn.—Closed, CPMs—Aug. 10)

EJC-ECPD Engineers General Assembly
Hotel Statler
New York, N. Y.
October 24-25, 1957

Machine Tool Conference
Hotel Schroeder,
Milwaukee, Wis.
November 4-6, 1957
(Final date for †TP—Aug. 5, ‡CP Syn.—Aug. 20, CPMs—Aug. 30)

Mid-Atlantic Textile Conference
North Carolina State College
Raleigh, N. C.
November 14-15, 1957
(Final date for †TP—Aug. 14, ‡CP Syn.—Aug. 27, CPMs—Sept. 6)

Magnetism and Magnetic Materials Conference
Park Sheraton Hotel,
Washington, D.C.
November 18-20, 1957
(Final date for †TP—Aug. 19, ‡CP Syn.—Sept. 3, CPMs—Sept. 13)

AIEE-IRE-ACM Eastern Joint Computer Conference
Park Sheraton Hotel,
Washington, D.C.
December 8-11, 1957
(Final date for †TP—Sept. 9, ‡CP Syn.—Sept. 24, CPMs—Oct. 4)

Winter General Meeting
Hotel Statler,
New York, N. Y.
February 2-7, 1958
(Final date for †TP—Nov. 1, ‡CP Syn.—Nov. 15, CPMs—Nov. 25)

EJC Nuclear Congress
International Amphitheater,
Chicago, Ill.
March 17-21, 1958
(Final date for †TP—Dec. 17, ‡CP Syn.—Jan. 1, CPMs—Jan. 10)

South West District Meeting
Tulsa, Okla.
March 31-April 2, 1958
(Final date for †TP—Dec. 31, §DP Syn.—Jan 14, DPMs—Jan. 24)

Middle Eastern District Meeting
Washington, D.C.
April 28-30, 1958
(Final date for †TP—Jan. 28, §DP Syn.—Feb. 11, DPMs—Feb. 21)

Great Lakes District Meeting
East Lansing, Mich.
May 5-7, 1958
(Final date for †TP—Feb. 5, §DP Syn.—Feb. 18, DPMs—Feb. 28)

East Central District Meeting
Huntington, W. Va.
May 13-15, 1958
(Final date for †TP—Feb. 13, §DP Syn.—Feb. 28, DPMs—March 10)

Summer General Meeting
Buffalo, N. Y.
June 23-27, 1958
(Final date for †TP—March 21, ‡CP Syn.—April 8, CPMs—April 18)

Pacific General Meeting
Sacramento, Calif.
August 19-22, 1958
(Final date for †TP—May 19, ‡CP Syn.—June 3, CPMs—June 13)

Fall General Meeting
Pittsburgh, Pa.
October 27-31, 1958
(Final date for †TP—June 27, ‡CP Syn.—Aug. 12, CPMs—Aug. 22)

*Final date for submitting papers—closed
†TP—Transactions Paper
‡CP Syn.—Conference Synopsis
CPMs—Conference Manuscript
(The CP Syn. date is 10 days before the CPMs date)
§DP Syn.—District Synopsis
DPMs—District Manuscript
(The DP Syn. date is 10 days before the DPMs date)

Celebration of 250 Years of Technical Schools in Prague

VICE-PRESIDENT Glenn Holcomb of the American Society of Civil Engineers and Past President M. D. Hooven of the AIEE (also president of Engineers' Council for Professional Development and director of Engineers Joint Council) attended the celebration of 250 years of technical schools in Prague on May 27 through May 30 as guests of the Republic of Czechoslovakia. Delegates from 21 nations attended. The British, French, Indian, Austrian, West German, and American representatives were quartered at the Alcorn Hotel. The treatment was "red carpet" to say the least, every facility and every convenience being made available. It was apparent that an extraordinary effort was made to accord the British and American delegates the same degree of recognition that was accorded the Soviet representatives, who, by the way, were very affable.

The celebration was inaugurated by the President of the Republic, Antonin Zapotocky, on May 27, 1957. The Minister of Education and Culture, Frantisek Kahuda, held a reception for foreign guests on the same evening.

A plenary session of the conference was held on May 28, each delegate delivering an address which was translated simultaneously into the necessary languages through the individual headset system. The Yugoslav address was probably the best received; it was an emotional declaration of the brotherhood between Yugoslavia and Czechoslovakia. The American address by Mr. Hooven was almost equally well received, although informal and not accompanied by a presentation such as the red silk banner on which was inscribed felicitations from the Chinese universities. The American address consisted simply of stating that the delegates represented 11 engineering societies in the United States and Canada, 153 engineering colleges, and 32 technical institutes, all combining to represent a half million engineers; that America was largely a wilderness at the time of the founding of the first technical schools in Prague; that Bohemia had founded an engineering college almost a century before the first American institution at West Point; that Americans were always proud to recognize leadership, particularly in the intellectual field; that, thus, America saluted Czechoslovakia.

Minister of Education Kahuda said that there are two political systems and that atomic energy will determine which will win. He quoted President Zapotocky as saying that the winner will be the order which favors progress—not to spread destruction but for the service of new creative effort. He stated that the U.S.S.R. was expending much more time and work on peaceful use of atomic energy than Britain or the United States. (A later Soviet speaker, however, gave credit to Palmer Putman for world energy figures.) In another portion of his talk, he stressed the point that science should not serve itself, but should serve the practical desires of the people, a point made several times by administrators but not by academic persons.

Tuesday evening was spent at the opera, which was a production of a Czechoslovak saga, "Libuse."

The next two days were devoted to technical sessions and inspections of the school properties. Classrooms and laboratories show much the same overcrowded conditions as they do everywhere. The technical sessions were in Czech and not easily understandable. The American delegates were interviewed in English for a radio broadcast.

The final formal event of the affair was a quite impressive dinner held in the rooms of the National Club. There were many toasts before the dancing. The Czech toast to America, following the one to the U.S.S.R., was a clever flashback to a previous technical paper on Equilibrium. The American response by Mr. Holcomb was congratulatory to the Czechs as a nation and as scholars.

Bimonthly Publications

The bimonthly publications, *Communication and Electronics, Applications and Industry,* and *Power Apparatus and Systems,* contain the formally reviewed and approved numbered papers presented at General and District meetings and conferences. The publications are on an annual subscription basis. In consideration of payment of dues, members (exclusive of Student members) may receive one of the three publications; additional publications are offered to members at an annual subscription price of $2.50 each. Nonmembers may subscribe on an advance annual subscription basis of $5.00 each (plus 50 cents for foreign postage payable in advance in New York exchange). Single copies, when available, are $1.00 each. Discounts are allowed to libraries, publishers, and subscription agencies.

1957 AIEE Fall General Meeting Will Be Held in Chicago, October 7-11

THE 1957 Fall General Meeting of the AIEE will be held in Chicago, Ill., October 7-11. Headquarters for the meeting will be at the Morrison Hotel.

Technical Sessions

Over 35 sessions will be held covering a wide range of electrical interests. At present, it is planned that the six Technical Divisions will include as broad a coverage of electrical subjects as possible. Committees on Safety, Education, and Management also will be represented.

Inspection Trips

One of the highlights of the Fall General Meeting will be a tour of the Argonne National Atomic Laboratories. This trip will prove interesting and beneficial to all AIEE members, as well as trips to Commonwealth Edison Company's Will County Generating Station, Automatic Electric Company, Electro-Motive Division of General Motors Corporation, various new shopping centers, Youngstown Sheet & Tube Company, Commonwealth Edison Company's IBM Computer Facilities, and Columbia Broadcasting System's new radio and television Studios.

Fall Frolics

Plans are well under way for the Annual Fall Frolics which will be held this year in the Morrison Hotel Terrace Casino on Wednesday, October 9, during the 1957 Fall General Meeting reports M. J. O'Laughlin, chairman of the committee.

Mr. O'Laughlin reminds the members that the ladies are cordially invited to attend and the Frolics are expected to be a sellout again. A never-say-die Chicago White Sox fan, O'Laughlin feels the event will be as big a sellout as the World Series at Comiskey Park will be and probably a better show.

Ladies Activities

A full week of activities, including a shopping trip to fabulous Old Orchard Shopping Center for the ladies attending the AIEE Fall General Meeting has been announced by Mrs. F. W. McCloska, ladies activities chairman.

The schedule in detail is as follows:

Sunday—Reception Tea in the Cotillion Room of the Morrison Hotel.

Monday through Friday—A Coffee Hour from 9:00 to 10:30 a.m.

Monday afternoon—Dessert Card Party in Ladies' Headquarters in the Walnut Room.

Tuesday—Tour of Old Orchard, Marshall Fields' new shopping center. Luncheon at Marshall Fields. Dorothy Bond, a syndicated cartoonist will speak. Time will be allotted for shopping. This luncheon is being spnsored by the Allis-Chalmers Manufacturing Company.

Wednesday—Brunch in the Cub Room of the Morrison Hotel. Betsy Ross, a well-known decorator from John A. Colby will speak on "Interior Decorating."

Thursday—Luncheon in the Crystal Room of the Chicago Athletic Club. Sulie Harand, a well-known entertainer, will give a musical play at this function. This luncheon is being sponsored by the Westinghouse Electric Corporation.

Friday—Program ends with the morning Coffee Hour.

Committee

The members of the Fall General Meeting Committee are: G. L. Welch, chairman;

E. H. Finch, vice-chairman; F. A. Larson, secretary; M. J. Adams, treasurer; F. E. Andrews, sale of papers; D. H. Beal, hospitality; D. K. Chinland, general session; D. W. Gilman, entertainment; C. A. Hatstat, technical program and monitors; Mrs. F. W. McCloska, ladies activities; M. J. O'Laughlin, fall frolics; C. E. Pigue, finance and budget; L. E. Randall, trips and transportation; D. J. Ryan, hotel arrangements; F. M. Scott, registration; and J. E. Smith, publicity.

1957 Winners of Sperry Award Announced

"For developing the diesel-electric locomotive which helped revolutionize American railroading" three of the early engineering and managerial personnel of the Electro-Motive Division of General Motors and four sections of the engineering department of the corporation will receive the 1957 Elmer A. Sperry Award, it was announced. R. B. Lea, chairman of the Sperry Board of Award, pointed out that, for the first time, a major engineering award will go not to one person but to a number of individuals and groups for their parts in a complex project.

The award was established in 1955 in honor of Elmer A. Sperry, many of whose achievements contributed to the field of transportation. These include not only the famous gyro compass and other sea and air navigation aids, but improved automobiles, trolley cars, and a rail flaw detector which adds to the safety of American railroads. The award is given each year for ". . . a distinguished engineering contribution which, through application proved in actual service, has advanced the art of transportation, whether by land, sea or air."

The three leaders who are to share in the award are:

H. L. Hamilton, Los Altos, Calif., retired vice-president of General Motors and founder of Electro-Motive, who was its leader through the entire period of the development until the General Motors diesel-electric locomotive was accepted in all branches of United States railroad service in 1940.

R. M. Dilworth of Hinsdale, Ill., retired, who was chief engineer of Electro-Motive from 1926 to 1951 and, as such, headed the research and design work which found fruition in the first successful application of the diesel-electric as a prime mover for the propulsion of trains of all classes.

E. W. Kettering of Hinsdale, Ill., now director of research, Electro-Motive Division at LaGrange, Ill., who, from 1936 to 1942 was in direct charge of the development of the General Motors *567* series diesel engine. This unit was the major element in broadening the capability of the diesel-electric locomotive to cover all phases of domestic railroad motive-power needs.

The four sections of the engineering department of Electro-Motive cited as having made major contributions to the achievement are: Controls Section, Electrical Engineering Section, Locomotive Section, and Mechanical Engineering Section.

"It should be explained," said Mr. Lea, "that in making this award the board took into account the fact that the period of development extended from the establishment of the definite concept of the diesel-electric locomotive in the early 1930s through 1940 when the work on the locomotive had progressed to the point where it was released for quantity production and numerous orders had been received from operating railroads. That marked, in our opinion, the point at which it might accurately be said that the diesel-electric locomotive had arrived. The three men designated to receive the award for 1957 were the major figures in the development to that point."

The 1957 awards will be formally presented during the 1957 Fall General Meeting of the AIEE at a special luncheon at the Morrison Hotel in Chicago, Ill., Thursday, October 10.

The Sperry Board of Award, in accordance with its founding charter, is made up of two representatives from each of four of the nation's leading engineering societies, as follows: the AIEE, the American Society of Mechanical Engineers (ASME), the Society of Automotive Engineers (SAE), and the Society of Naval Architects and Marine Engineers (SNAME).

The associates of Chairman Lea (of the ASME) on the board making the 1957 awards are: David Morgan, ASME; J. C. Hunsaker and William Littlewood of the SAE; E. H. Anson and W. N. Zippler of the AIEE; and H. L. Seward and C. R. Waller of SNAME. C. E. Davies is secretary of the board.

The Sperry Award was presented in 1955 to W. F. Gibbs, for the concept and design of the *S.S. United States* and in 1956 to D. W. Douglas, for developing the "DC" series aircraft.

R. J. Rockwell Announced as Winner of 1957 Marston Medal

R. J. Rockwell (F '56) was announced at the June Commencement exercises of Iowa State College as the 1957 winner of the Marston Medal. The medal is awarded annually in memory of the late Dean Anson Marston of the Division of Engineering to an alumnus in recognition of outstanding achievement in the field of engineering.

Mr. Rockwell, a 1927 graduate in electrical engineering, was born in Omaha in 1904. When only 12 he obtained a license for amateur radio station 9VE, and started a daily broadcast for the Omaha Weather Bureau in 1920. When such amateur broadcasting was prohibited, the station was given a new license and became WNAL. In 1922, WOAW (now WOW) was constructed and Mr. Rockwell became chief engineer. In 1923, he entered Iowa State College.

After graduation from Iowa State, he joined the staff of the General Electric Company as a test engineer. In 1928, he resigned and became a consultant engineer for broadcast stations.

In 1929, he joined the Crosley Corporation as engineer in charge of audio circuit and speaker development. In 1946, when the broadcasting branch of the company was incorporated as the Crosley Broadcasting Corporation, Mr. Rockwell became vice-president and director of engineering of the new organization.

During his association with the Crosley Corporation, Mr. Rockwell's engineering and administrative activities have been many and varied, including much pioneering in electronic circuitry and in high power broadcasting. In the field of television, Mr. Rockwell was responsible for design and construction of Ohio's first television station, WLWT.

In the development of high-fidelity radio, Mr. Rockwell has been granted several patents of a basic nature covering circuitry now used by many manufacturers, and of more recent date is his new high-fidelity modulation system for AM transmission known as the "Rockwell Cathanode Modulation System."

Mr. Rockwell is a member of nine professional societies and a Fellow of the Institute of Radio Engineers. He was given the "Outstanding Engineering Award for 1956" by the Engineering and Scientific Societies Council of Cincinnati.

Mr. Rockwell is a holder of over 20 United States patents covering radio and television transmission and receiving equipment.

The Marston Award, represented by the medal, was established by Iowa State College in 1938. The award was inspired by Anson Marston, professor of civil engineering from 1892-1920, dean of engineering from 1904-1932, and dean emeritus at the time the award was established.

A Board of Award selects a winner each year. On the board is one representative from each of four engineering societies: AIEE, American Society of Civil Engineers, American Society of Mechanical Engineers, and American Institute of Chemical Engineers. Four members are engineering alumni, one chosen each year for a four-year term by the class which is celebrating its 25th year reunion. The dean of engineering of the Iowa State College is ex-officio chairman of the board.

The award is made only to an engineering alumnus of at least 30 years standing. Since 1939, no candidate has been eligible

Courtesy Ken Rarick

R. J. ROCKWELL (F '56), vice-president and director of engineering, Crosley Broadcasting Corporation, winner of the 1957 Marston Medal.

for election until his name has been before the Board of Award for one year. The term "engineering alumnus" means one who has received an earned bachelor's, master's, or doctor's degree in some branch of engineering at Iowa State College.

Eligible for the award are graduates engaged in technical design and construction and those who plan, develop, and manage enterprises in the fields of manufacturing utilities and civic betterment as well as engineering, teaching and research, and activities in national engineering societies.

Conference on Solid-State Devices Held April 22-23, 1957

Some 200 engineers, scientists, industrialists, and educators met at The Catholic University of America, Washington, D. C., for a Special Technical Conference on Solid-State Dielectric and Magnetic Devices held April 22-23. Highlight of the conference were the two invited papers: "On Some Old, New and Yet-Undiscovered Ferroelectrics and Other Interesting Dielectrics," by Dr. Ray Pepinsky of Pennsylvania State University and "A Survey of the Use of Magnetic Elements as Manipulator of Digital and Analog Information," by Dr. J. A. Rajchman of the RCA Laboratories. Other papers were presented by C. F. Pulvari, Wolf Kuebler, and G. E. McDuffie, Jr., of Catholic University; Sol Triebwasser of the International Business Machines Corporation; H. H. Wieder of the U. S. Naval Ordnance Laboratory, Corona, Calif.; R. C. Powell of the National Bureau of Standards; J. H. Armstrong, H. L. Stadler, E. E. Schwenzfeger, and N. J. Herbert of the Bell Telephone Laboratories; C. M. Davis and S. F. Ferebee of the U. S. Naval Ordnance Laboratories in White Oak, Md.; I. Wolf, T. E. Bray, and B. Silverman of the General Electric Company; A. T. Balint of the University of Buffalo; J. D. Childress of the General Ceramics Corporation; H. Diamond and V. Chang of the University of Michigan; G. Marks and L. A. Monson of the U. S. Navy Electronics Laboratory in San Diego, Calif.; and E. L. Brancato and J. G. Allard of the U. S. Naval Research Laboratory in Washington, D. C.

A special feature of the conference—the demonstration of present research in ferroelectrics being performed by members of the department of electrical engineering at Catholic University—drew keen and unexpected interest.

The following groups co-operated with the department of electrical engineering at Catholic University in sponsoring the conference: AIEE Solid-State Devices Committee, Institute of Radio Engineers (IRE) Professional Group on Electron Devices, the IRE Technical Committee 28, and the Aeronautical Research Laboratory of the Wright Air Development Center.

Proceedings of the conference may be obtained by sending a check or money order for $3.50 to the Conference Chairman, Prof. J. C. Michalowicz, Electrical Engineering Department, The Catholic University of America, Washington 17, D. C.

EJC and ECPD Announce Engineers General Assembly

In a joint statement made on May 28 Dr. J. W. Barker and M. D. Hooven, presidents respectively of Engineers Joint Council (EJC) and Engineers' Council for Professional Development (ECPD) announced the scheduling of the Engineers General Assembly, a conference of the two organizations, for Thursday and Friday, October 24-25, at the Statler Hotel, New York, N. Y.

The Assembly constitutes the first organizational step in the co-ordination of the activities of EJC and ECPD, as a recognition of the essential unity of the profession and of the common goals of the two major engineering organizations.

The statement further reads:

"The EJC—ECPD joint program committee has developed an outstanding program that will reflect the common interests of the organizations in the professional and social development of the engineer. The two groups have long recognized their closely paralleled activities and we are delighted at this singularly important step in bringing together their annual meetings and in providing a fully integrated program for the profession."

The program will consist of panel discussions: Thursday morning—Military Service as a Factor in Professional Development; Thursday afternoon—The Community College in Technological Education; Friday morning—The Place of the Engineer in Industrial Management; Friday afternoon—New Dimensions in Postgraduate Education for Engineers.

The joint committee will issue shortly further details on the program and speakers, including the main social function, the Assembly Dinner, which will recognize particularly ECPD's 25th Anniversary.

The ECPD is a conference of engineering societies with the National Council of State Board of Engineering Examiners and the Engineering Institute of Canada, primarily responsible for accreditation of engineering college curricula and for the early career development of the engineer.

EJC is a federation of 15 major engineering societies with a combined membership of 250,000 and represents the engineer more fully as a degree-holding professional.

W. A. Farris Named Chairman of Cincinnati Section

W. A. Farris, electrical engineer with Ohio River Division Corps of Engineers, has been elected chairman of the Cincinnati Section of AIEE. He succeeds D. T. Michael. Mr. Farris has been active in Section affairs for many years.

Other officers named at the annual election were: H. S. Progler, vice-chairman; A. C. Stewart, secretary-treasurer; L. E. Bertke, assistant secretary; G. J. Brunner, F. M. Foster, and N. L. Heberer, directors. L. H. Coffin, C. F. Evert, and R. B. Fulton are the three other directors of the Section.

The Cincinnati Section was formed in 1920 and has a membership of 410.

New Officers of Mexico Section Installed

The installation of officers of the Mexico Section of AIEE was held on May 30, 1957.

Past Chairman Ing. G. Solís Payán gave the oath of office to incoming Chairman Ing. Julio Colón and the new Board of Directors.

The wives of 17 members attended the meeting and Ing. Boris Antipovich, who is a well-known painter, donated one of his works in oil as a door prize, which was won by Mrs. A. W. Gelbke.

Ing. J. Mireles Malpica, member of the National Atomic Committee of Mexico, gave a talk on the first man-made atomic explosion and its history. A motion picture on "Uranium" was shown by courtesy of the United States Embassy.

AT THE INSTALLATION OF OFFICERS of the AIEE Mexico Section, Past Chairman Ing. G. Solís Payán (*right*) gave the oath of office to incoming Chairman Ing. Julio Colón and the new Board of Directors.

Lehigh Valley Section Elects Officers for 1957-58

The Lehigh Valley Section Board of Managers Annual Meeting was held on May 24, 1957, in Hometown, Pa. At this meeting, F. S. Fehr, 1956-57 Section chairman, announced the officers that have been elected for 1957-58. They are: Chairman, W. F. Dunkle; Vice-Chairmen, C. J. Mayer, I. M. McNair and A. W. Plonsky; Secretary-Treasurer, L. L. Nonemaker. Division Managers are: R. B. Roush, Allentown; J. Teno, Bethlehem; H. W. Leas, Easton; T. A. Wolfe, Hazleton; M. A. Buchta, Reading; F. P. Fletcher, Scranton; J. C. Engle, Sunbury; A. J. Fladd, Wilkes-Barre; and D. Y. Brouse, Williamsport.

SOME OF THE INCOMING MEMBERS of the Lehigh Valley Section Board of Managers are: (*seated, left to right*) L. L. Nonemaker, W. F. Dunkle, I. M. McNair, A. W. Plonsky, E. Hansen, M. C. Galiyano, (*standing, left to right*) S. S. Lesh, J. E. Roth, J. N. Green, E. R. Winkelspecht, M. A. Buchta, J. K. McDonald, D. Y. Brouse, H. R. Steward, R. B. Roush, J. W. Gehrke, F. P. Fletcher, F. S. Fehr, W. F. Mackenzie, P. H. Robbins, H. W. Leas, J. S. Stetler, T. A. Wolfe, J. Teno.

Textile Industry Conference Will Be Held in Raleigh, N. C.

The sixth annual Conference on Electrical Applications for the Textile Industry, which is sponsored jointly by the Textile Industry Subcommittee of the General Industry Applications Committee of the AIEE and North Carolina State College, will be held in Raleigh, N. C., November 14-15, 1957, at the Riddick Laboratory Auditorium on the campus of North Carolina State College.

The program will consist of three sessions featuring speakers of national prominence on electrical equipment and applications. Registration and a tour of the Engineering Laboratories will take place on Thursday, November 14, until noon. The first session will begin at 1:30 p.m., followed by a social hour and dinner at the Sir Walter Raleigh Hotel that evening. Friday morning, there will be another meeting with papers presented of particular interest to the Textile Industry. After a planned luncheon, the afternoon session will conclude with an open forum discussion of "What's New in Textile Electrical Equipment."

This North Carolina State Textile Conference has been extremely informative and well received since its inception. The majority of those attending are directly connected with textile mills in either the design, installation, or maintenance of electrical equipment. The discussions which follow the presentation of the papers accomplished the purpose of this conference which is to serve the industry through better electrical applications.

AIEE Pittsburgh Section Celebrates 53rd Anniversary

On April 2, some 420 persons attended the Pittsburgh Section's 53rd Anniversary Dinner Meeting. This was the largest crowd that has ever attended an anniversary dinner meeting of the Pittsburgh Section. Of those attending, 151 were AIEE student members.

The dinner meeting ended a busy day of activities centered around the student members. The students had attended a conference at the Mellon Institute where the prize papers were presented and later toured the Pennsylvania Transformer Company in Canonsburg, Pa.

At the dinner, prizes were awarded as part of the District Prize Paper Contest. The first prize of $50 went to J. T. Raleigh of Pennsylvania State University for his paper, "A Classroom Comunication System for Closed Circuit Television Instruction." The second prize of $25 went to D. C. Dillon of West Virginia University.

Guest speaker for the evening was J. L. Young, vice-president, engineering, United States Steel Company. His talk was entitled "Engineering Manpower." Mr. Young centered his talk around the idea that the engineer in industry today not only should be solidly grounded in his technical or scientific field but also should be provided with time to think and to use his ability to be creative. In addition, the engineer should be adequately educated in humanities not only to teach him how to communicate skillfully in the oral and written field, but also to enable him to take into proper account and act upon the economic, political, and social implications of his work.

In conjunction with the annual dinner meeting, Mr. Young also was on a 15-minute television program entitled "Key to the City." This was an interview-type of program during which Mr. Young and Miss Elkus, mistress of ceremony, discussed the

W. H. OSTERLE (*second from left*), chairman of the Pittsburgh Section, presents first prize for the Prize Paper Contest to J. T. Raleigh (*left*), student at Pennsylvania State University. C. T. Pearce (*second from right*), vice-president of AIEE District No. 2; and Jack Keeney (*right*), student chairman, West Virginia University, observe the presentation.

topic, "The Engineer's Responsibility to His Community."

The Annual Dinner Meeting also had television coverage on the news program "Pitt Parade." This is the program which covers all of the important events occurring in Pittsburgh each week.

New President of CIGRE Announced

Dr. Ing. Prof. Giovanni Silva (M '51), general manager of Compagnia Nazionale Impresse Elettriche, Rome, Italy, was elected president of Conference Internationale des Grands Reseaux (CIGRE) at their recent reunion in Amsterdam.

Dr. Silva was born in Asti, Italy, on May 3, 1897. He was graduated from Politecnico di Torino (Italy) in 1920 and then served as professor of electrical technology at the Politecnico di Milano (Italy). During his career, he served as manager of several telephone companies and as manager of the Association of the Italian Electric Public Utilities. In 1943, he became general manager of the Compagnia Nazionale Impresse Elettriche.

In 1931, Dr. Silva became an editor of *L'Elettrotecnica*, published by the Italian Electrical Association. An authority on transmission lines and rotating electrical machinery, he has published numerous technical papers in Italian, French, Swiss, German, and English technical journals.

Long active in CIGRE, he has served as president of the Overhead Lines Committee and as vice-president of the international association.

DR. GIOVANNI SILVA, newly elected president of Conference Internationale des Grands Reseaux (CIGRE).

Spokane Section Officers

THE NEWLY ELECTED OFFICERS of the AIEE Spokane Section for 1957-58 are shown with M. M. Ewell, AIEE District No. 9 vice-president, Westinghouse Electric Corporation, Portland, Oreg. The officers are: (*left to right*) R. D. Brown, Section chairman, Allis-Chalmers Mfg. Company; L. C. Ford, Section vice-chairman, General Electric Company, Spokane, Wash.; Mr. Elwell; W. A. Morgan, Section secretary-treasurer, Washington Water Power Company, Spokane.

AIEE Michigan Section Sponsors Annual "Ladies Day"

On May 14, members of the Michigan Section of the AIEE and their wives enjoyed an afternoon outing, an evening dinner, and heard an interesting speaker at the Consumers Power Employees Club at Clark Lake, Mich.

The event was the annual "Ladies Day" and was attended by over 100 persons. Activities began shortly after 3 p.m. and included various outdoor games, contests, and prizes.

The after-dinner speaker was Fred Wight, of Ann Arbor, Mich., administrative assistant of the Michigan Children's Institute. His subject was "Child Welfare" and dealt with the role the Michigan Children's Institute performs in providing care for homeless children.

A short business meeting was held during which F. Von Voigtlander, chairman of the Michigan Section, named the new officers for the coming year.

J. J. Fredrickson of the local General Electric Company office was general chairman for the event and A. Hoffmeister of the local Westinghouse Electric Corporation office had charge of the dinner. J. M. Waters of Commonwealth Associates, Inc., was in charge of the program and M. J. Nisja of Consumers Power Company was in charge of the Contact Committee.

J. J. Owens had charge of the entertainment and was assisted by R. Hamilton and B. O. Johnson, all of whom are of Commonwealth Associates, Inc.

A travelogue film of Japan was shown at the end of the Ladies Day event.

Topics Announced for National Electronics Conference

More than 90 papers, including a number of tutorial discussions aimed at stimulating cross-fertilization of ideas in related scientific fields, will be presented at the 13th Annual National Electronics Conference October 7-9 at the Hotel Sherman, Chicago, Ill.

The tutorial papers will cover new techniques that affect the electronics industry, engineering to improve electronic aids to the medical profession, radio astronomy, and geophysics.

Upwards of 80 technical papers will be devoted to the latest developments in transistor and computer research, electronic components reliability in extreme environments, and other areas of research.

Topics slated for discussion will include: circuit theory, circuits, communications, components and materials, computers, electron tubes, engineering management, instrumentation, magnetic circuit devices, medical electronics, microwaves, radar and radio navigation, semiconductor devices, servomechanisms, and transistor circuits.

Three luncheon speakers, a large commercial exhibit of the newest electronic devices, social events, and specially programmed activities for the wives of conferees are included in the three-day program.

The National Electronics Conference,

which is sponsored annually by a group of colleges, universities, and technical societies, is the nation's leading forum on electronic research, development, and application.

The sponsoring institutions are the AIEE, Illinois Institute of Technology, Institute of Radio Engineers, and Northwestern and Illinois Universities.

Co-operating organizations are the Universities of Michigan, Michigan State, Notre Dame, Purdue, and Wisconsin, the Radio-Electronics-Television Manufacturers Association, and Society of Motion Picture and Television Engineers.

Attendance at the 1957 conference and exhibit is expected to total approximately 10,000 persons, principally scientists, engineers, educators, manufacturers, Government officials, and students.

Inquiries concerning the conference should be addressed to National Electronics Conference, 84 E. Randolph St., Chicago 1, Ill.

Lamme Medal Nominations for 1957 Due December 1

Special attention is directed to the fact that the names of Institute members who are considered eligible for the AIEE Lamme Medal, to be awarded early in 1958 may be submitted by any member in accordance with section 1 of article VI of the bylaws of the Lamme Medal Committee, as follows:

"The Committee shall cause to be published in one or more issues of *Electrical Engineering*, or of its successors, each year, a statement regarding the Lamme Medal and an invitation for any member to present to the Secretary of the Institute by December 1, the name of a member as a nominee for the medal, accompanied by a statement of his 'meritorious achievement' and the names of at least three engineers of standing who are familiar with the achievement."

Each nomination should give concisely the specific grounds upon which the award is proposed, and also a complete detailed statement of the achievements of the nominee, to enable the committee to determine its significance as compared with the achievements of other nominees. If the work of the nominee has been of a somewhat general character in co-operation with others, specific information should be given regarding his individual contributions. Names of endorsers should be given as specified in the foregoing quotation.

Article V, section 2, specifies that: "The committee in making the award shall carefully observe the limitation imposed by Mr. Lamme, that the recipient must have 'shown meritorious achievement in the development of electric apparatus and machinery.' This shall be taken to mean that the meritorious achievement must be of such character that it has resulted or will result in the production of substantially improved electric apparatus or machinery. Any work which meets this requirement is admissible whether it be (a) in development of the theory involved; (b) in development of the characteristics of the materials employed; (c) in development of over-all design; or (d) in development in other ways which results in substantial improvement in electric apparatus or machinery. The words 'electric apparatus or machinery' shall be taken to indicate discrete and self-contained devices which may or may not include mechanical moving parts without limitation as to the field of application. They shall not be taken to include transmission or distribution systems as a whole, but rather to include the apparatus and machinery that is used in making up such systems."

Progress Being Made in Switchgear Standardization

Noteworthy progress is being made in the field of switchgear standardization by the American Standards Association (ASA) through its Sectional Committee on Power Switchgear C37 under the chairmanship of V. L. Cox (F '50).

Since 1950, this group has prepared and obtained ASA approval of 16 standards covering a wide range of switchgear products. These have all been published by ASA and are available from ASA Headquarters to anyone interested in the design, manufacture, application or use of switchgear.

They include definitions, preferred rating schedules, application guides, guide specifications, and test codes. Among the more important products covered are high and low voltage power circuit breakers, switchgear assemblies, metal-enclosed bus, automatic station control, supervisory control and associated telemetering and protective relays.

The Committee has active subcommittees presently at work on revision of high and low voltage power circuit breaker standards and on new proposed ASA standards covering: automatic circuit reclosers and line sectionalizers, high voltage air switches, high voltage fuses and coupling capacitors, capacitor potential devices, and line traps.

In order that the standards may be most useful to both users and manufacturers, the Committee and its subcommittees are composed of nearly equal groups of members from both areas. The members are usually recommended by private and Government user organizations and by the National Electrical Manufacturers' Association (NEMA) representing manufacturers. The work of AIEE technical committees as approved by the AIEE Standards Committee forms the basis for many of the standards developed. Standards on high voltage power circuit breakers also are based on the recommendations of an Edison Electric Institute–Association of Edison Illuminating Companies–NEMA joint Committee on Power Circuit Breakers.

Many of the members of AIEE and user and manufacturer association standardizing committees also are members of the ASA Committee and its subcommittees, thus assuring that the work of ASA will be carried on with full knowledge of the work and thinking of these other groups.

United States participation in international switchgear standardization also clears through the ASA Sectional Committee on Power Switchgear whose chairman is technical advisor on switchgear to the U.S. National Committee (USNC) of the International Electrotechnical Commission (IEC). Advice of the ASA Committee and its subcommittees is used by the technical advisor in recommending to the USNC the position it should take with respect to standards proposals submitted by IEC for comment or approval by its National Committees.

D. A. Quarles To Receive Award of Merit from AICE

E. H. Anson (M '54), president of the American Institute of Consulting Engineers (AICE), has announced that at the 47th Annual Dinner of the AICE to be held at the Waldorf-Astoria, New York, N.Y., on October 15, 1957, the Hon. D. A. Quarles (F '41), Deputy Secretary of Defense, and past president of AIEE, 1952-53, will receive the AICE Award of Merit for distinguished achievement in engineering, as well as in the service of the Government. Previous recipients have been: the Rt. Hon. Clarence Decatur Howe, Dr. Vannevar Bush, Hon. Herbert Hoover, Benjamin F. Fairless, and Ralph Budd.

EJC Completes Report on Engineering Education Facilities

One of the largest freshman engineering classes (second only to the 1946 class—with the large GI influx) enrolled in the engineering colleges of the country in 1956. There is no evidence that qualified students are being turned away from engineering colleges and currently there is no shortage of engineering students. Although best with serious problems, notably faculty availability and student selection, engineering educational facilities have, in general, comfortably assimilated this enrollment.

These conclusions are a result of a survey recently completed by the Engineering Manpower Commission of Engineers Joint Council (EJC). Replies were received from 169 colleges with about 90% of the country's 1956-57 freshman engineering enrollment.

The 14-page report evaluates the current available engineering educational facilities, freshman capacity and enrollment, and capacity expansion programs under way across the nation. The data are classified by consideration of accreditation (by Engineers' Council for Professional Development) and of control (private and public) plus geographic location of colleges.

The report of the survey "Engineering Educational Facilities—1957" (report *104*) is available at Engineers Joint Council, 29 W. 39th St., New York 18, N. Y., copy: 25¢.

EJC is a federation of professional engineering societies with a combined membership of over 250,000 engineers.

Dr. Harry Stanley Rogers, President of Polytechnic, Dies

Dr. Harry Stanley Rogers, fifth president of the Polytechnic Institute of Brooklyn, died June 6, 1957. His age was 66.

Dr. Rogers assumed the presidency of Polytechnic in 1933, following a term as dean of engineering at Oregon State College.

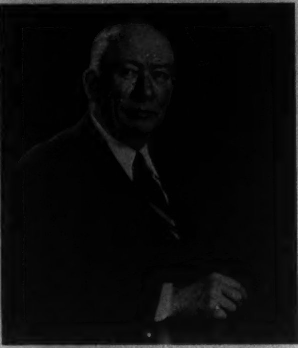
When he undertook the presidency, the total enrollment of Polytechnic was less than 2,000 students, and the school had a mortgaged debt of $600,000.

Under his leadership, the over-all enrollment more than trebled and Polytechnic witnessed a ninefold expansion of its graduate enrollment. At the beginning of his incumbency, sponsored research in the nine scientific and engineering departments was nonexistent. At the time of his death, sponsored research in the Institute represented annual expenditures of more than $2.25 million.

Dr. Rogers was born in Detroit, Mich., on August 7, 1890. He received his B.S. degree from the University of Wyoming in 1914 and the civil engineering degree in 1926. He was awarded an honorary LL.B. from his alma mater in 1942, an honorary doctor of science degree from Northeastern University in 1935, and the doctor of engineering degree from Rensselaer Polytechnic Institute in 1950.

After graduating from the University of Wyoming, he served as an instructor in civil engineering at the Universities of Iowa, Wyoming, and Washington, and as assistant professor of civil engineering at Lafayette College, Pa.

In 1919, he left education to become a design engineer with the Truscon Steel Company, but returned to education in 1920 as professor of hydraulics and irrigation engineering at Oregon State College. In 1927, he was appointed dean of engineering and in 1928 the first director of the Engineering Experiment Station at Oregon State College. He served at Oregon State until the fall of 1933 when he accepted the appointment as president of Polytechnic.



Courtesy Du Rona

DR. HARRY STANLEY ROGERS, fifth president of Polytechnic Institute of Brooklyn, who died on June 6, 1957.

Throughout his career Dr. Rogers had been active in the work of the American Society for Engineering Education (ASEE), serving several terms on the Council, one term as vice-president, and two terms as president, one of two men to hold the presidency twice.

In 1953, Dr. Rogers was awarded the Lamme Award of the ASEE as the 26th recipient of the highest honor in the field of engineering education.

During the Centennial Celebration of Polytechnic in 1954-55, Dr. Rogers was honored by numerous professional and civic groups, including The Royal Aeronautical Society (Great Britain), The Society of American Military Engineers, the National Society of Pershing Rifles, and the Brooklyn Civic Council.

Dr. Rogers was active in the Engineer's Council for Professional Development (ECPD) throughout its entire history, having been a member of the original Engineering Education Committee, a member of the Professional Training Committee, for nine years a member of the Council, and for three years its chairman.

He was prominently identified with educational, civic, and business interests. He served as vice-chairman of the Board of the Long Island College of Medicine, as a member of the Board of Higher Education of the City of New York, a member of the Board of the Associated Colleges of Upper New York, and a member of the Board of Visitors of the Air University, U. S. Air Force.

He was president of the Brooklyn Chamber of Commerce, the Rotary Club, and the Downtown Brooklyn Association.

Further Plans Made for 1958 Nuclear Congress

Co-ordinated by Engineers Joint Council (EJC) for its member societies and managed by the American Institute of Chemical Engineers (AIChE), the 1958 Nuclear Congress will be held March 17-21 at the International Amphitheater in Chicago, Ill.

During the 4th Nuclear Engineering and Science Conference, March 17-21, a wide variety of technical papers will be given on subjects in keeping with the 1958 Nuclear Congress theme – "Industrializing the Atom."

Other events which will be part of the 1958 Nuclear Congress are:

The 6th Atomic Energy in Industry Conference, March 17-19. These conferences are designed to provide management with a comprehensive review of the progress that is being made throughout the world toward the development of low-cost nuclear power and other industrial uses of nuclear energy.

The 6th Hot Laboratories and Equipment Conference, March 19-20. Technical papers will be presented by the designers and operators of laboratories handling radioactive materials. The four sessions will cover new developments in: hot laboratories and cells, remote handling equipment, and hot cell operation.

The 4th International Atomic Exposition, March 16-21. On display for inspection and comparison will be the equipment, products, and services of virtually every major supplier for the atomic industry. Many of the products shown will never before have been seen outside the manufacturers' plants.

American Power Conference, March 17-19. Papers on nuclear power will be presented on March 19 in conjunction with the 1958 Nuclear Congress.

M. M. KOCH (*center*) receives Fellow Certificate from Denver Section Chairman M. H. Kight (*left*) as sponsoring Fellow L. R. Patterson (*right*) observes.

AIEE Denver Section Takes Trip to Leadville, Colo.

A meeting was held for the AIEE Denver Section at Leadville, Colo. on April 27, 1957. The purpose of the meeting was to inspect the 500-kv test line which Public Service Company of Colorado recently constructed in co-operation with several manufacturers who supplied materials for the line and test. The meeting was jointly sponsored by the Power Systems Group and Electric Equipment Group.

Dr. L. M. Robertson, chief electrical engineer, Public Service Company of Colorado, began the meeting with a discussion of the history and purpose of the high voltage test line. His talk was accompanied by colored slides showing the various stages of construction of the line and test facilities.

After Dr. Robertson's talk, the group inspected the test setup, which included the transformer installation, instrumentation, tower, and line construction. The line was energized at several different voltage levels, one phase at a time, to illustrate the effect of conductor arrangement and operating voltage upon audible noise levels.

Despite disagreeable weather (commonly encountered at a 10,000-foot altitude) and a travel distance of 115 miles, the meeting was well attended. Everyone attending had a very enjoyable and educational trip.

Standards Council Honors Former Member

The Standards Council of the American Standards Association (ASA) at its meeting on April 26, 1957, passed the following resolution in regard to the late Charles Rufus Harte (F '46), former member of the Council:

"RESOLVED

> that the Standards Council of the American Standards Association, in the knowledge that Charles Rufus Harte passed away on November 13, 1956, contemplates with sadness and regret this loss of our fellow member who served the Association in the cause of standardization for thirty-four years in innumerable ways, with devotion, outstanding leadership, and adherence to the principles of the Association, which principles he helped to form; and be it

"RESOLVED further

> that a copy of this resolution and the preceding remarks be spread upon the minutes of this meeting of the Standards Council, that copies be sent to the children of Mr. Harte as an expression of our sympathy, to the American Institute of Electrical Engineers, and to the American Transit Association."

The association standards activities of Mr. Harte began in the American Electric Railway Engineering Association (AEREA) about 1916 and in a sectional committee of the American Engineering Standards Committee (AESC) in 1923. In 1924, he was appointed representative of the AEREA (later named the American Transit Association) on the Main Committee of the AESC, which became the present Standards Council, and on which he served, practically without interruption, until last November.

Mr. Harte's obituary appeared on page 91 of the January 1957 issue of *Electrical Engineering*.

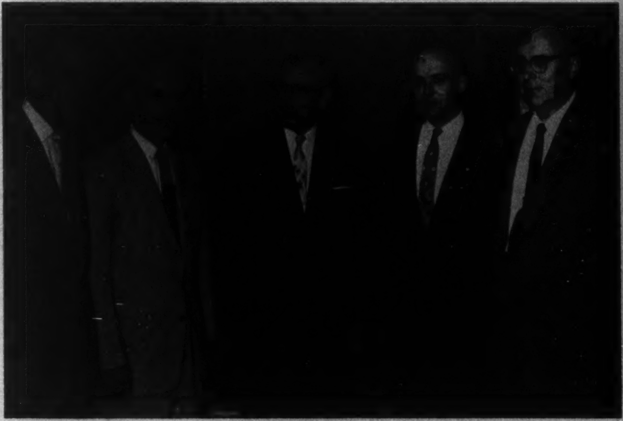
IEC Delegates Meet in Moscow

Delegates from the electrical industry represented the U. S. National Committee of the International Electrotechnical Commission (IEC), an arm of the American Standards Association (ASA), at the 16 technical committee meetings held in Moscow, U.S.S.R., July 2-12. R. C. Sogge (F '53),

Appliance Technical Conference

INSTRUMENTAL in the Eighth Annual Appliance Technical Conference May 20-21, at the Engineering Society of Detroit were: (*left to right*) Prof. E. Boyce, chairman of the department of civil engineering, University of Michigan, and president of the Engineering Society of Detroit; W. R. Milby, general chairman of the conference, assistant director of Customers' Service Division, Detroit Edison Company; H. F. Hoebel, chairman of the AIEE Domestic and Commercial Applications Committee; D. C. Krammes, chairman of the Domestic Appliances Subcommittee; and E. O. George, vice-president, Detroit Edison Company, conference keynote address. The conference, attended by approximately 200 persons, was sponsored by the Domestic and Commercial Applications Committee, the Domestic Appliances Subcommittee, and the Michigan Section of AIEE.

Iowa-Illinois Section Officers



WE. E. KEEFE, Bettendorf, Iowa (*second from right*), was elected chairman of the Iowa-Illinois Section of the AIEE at a meeting held at the Park Lane Country Club in Muscatine, Iowa. AIEE President M. S. Coover (*center*) was present at the installation of the new officers. L. L. Corbin, Bettendorf, (*left*) is the new secretary-treasurer and C. W. Lauritzen, Rock Island, Ill., (*right*) is the new vice-chairman. F. D. Newberry, Muscatine, (*second from left*) served as Section chairman during the past year. Other new officers not shown in the photograph are A. C. Gremmels, Dubuque, Iowa, and T. M. Shoemaker, Rock Island, members of the Executive Committee.

Conference Papers Open for Discussion

Conference papers listed below have been accepted for AIEE *Transactions* and are now open for written discussion until August 26. Duplicate double-spaced typewritten copies of each discussion should be sent to E. C. Day, Assistant Secretary for Technical Papers, American Institute of Electrical Engineers, 33 West 39th St., New York 18, N. Y., on or before August 26.

57-61 **Signal-to-Noise Ratios in Strong-Carrier FM Systems.** *Harry Urkowitz*
57-94 **Dynamic Operation of Magnetic Amplifiers with Real Core and Rectifier Functions.** *H. C. Bourne, Jr., D. Nitzan*
57-391 **The Application of Negative Impedance Repeaters on Long Rural Telephone Lines.** *H. T. Uthlaut, Jr.*
57-470 **Voltage Modulation on Aircraft Power Systems.** *R. E. Klockow, C. F. Yohe*
57-471 **Design of Generating Equipment for Electra Turboprop Aircraft.** *J. R. M. Alger, W. E. Warden, W. O. Hanson, L. Klein*
57-479 **A Method of Fault Analysis for A-C Aircraft Electric Power Systems.** *L. J. Rindt, R. D. Jessee*
57-489 **Salient-Pole Permanent Magnet Alternators for High-Speed Drive.** *A. T. Puder, Fritz Strauss*
57-491 **Silver Zinc Batteries as a Source of Primary Electric Power for a Pilotless Aircraft.** *L. T. Abrahamson*
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57-771 **A Magnetic Amplifier Voltage Current Overload Protection Circuit.** *R. J. Distler, C. Sturzenbecker*
57-782 **Stability and Physical Realizability Considerations in the Synthesis of Multipole Control Systems.** *Herbert Freeman*
57-792 **Design of an Improved Two-Stator Watthour Meter.** *D. M. Smith*
57-793 **Silicon Rectifiers in Brushless Machinery.** *H. W. Henkels, H. R. Camp, J. R. Fortier, W. J. Shilling, R. E. Smith*

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president of the U. S. National Committee, headed the 24-man delegation.

The delegates are: Mr. Sogge, General Electric Company; H. S. Osborne (F '21), consultant (formerly American Telephone and Telegraph Co. and past president of AIEE and of IEC); G. F. Hussey, Jr., ASA; S. D. Hoffman (AM '47), ASA; H. Blackmon (F '49), Westinghouse Electric Corporation; E. F. W. Beck (F '53), Westinghouse Electric Corporation; L. W. Cole (M '43), Federal Pacific Electric Company; E. C. DeBlieux, General Electric Company; C. L. Dawes (F '35), Harvard University; J. H. Foote (F '32), Commonwealth Associates, Inc.; G. W. Heumann (M '46), General Electrical Company; E. A. Harty (F '53), General Electric Company; L. F. Hunt (F '38), Southern California Edison Company; J. G. Hutton (M '46), General Electric Company; W. M. Leeds (F '48), Westinghouse Electric Corporation; G. F. Lincks (M '44), General Electric Company; C. H. Linder (F '57), General Electric Company; W. P. Lowell, Jr., Sylvania Electric Products, Inc.; J. W. May (M '45), ITE Circuit Breaker Company; L. W. Morton (F '51), General Electric Company; I. R. Smith (AM '43), Westinghouse Electric Corporation; F. Ullman (M '37), Westinghouse Electric International Company; F. R. Wolfe, National Carbon Company; and W. F. Doxey, U. S. Army Signal Laboratory.

Progress Made on Plans for Engineering Profession Survey

Plans to conduct the most important and comprehensive survey of the engineering profession ever undertaken, progressed with the appointment of a joint task group of Engineers Joint Council (EJC) and Engineer's Council for Professional Development (ECPD) that will design a specific program to be used to solicit supporting funds in order to conduct the survey.

The Committee will work within the framework of proposal of the Report of the Joint Committee of the ECPD and EJC on a Survey of the Engineering Profession, submitted to the constituent members of the organizations in September 1956 and endorsed by the ECPD and EJC. The present task committee will draw on a fund of $50,000 appropriated by the societies to initiate the survey. The final proposal is anticipated in the near future.

The task committee is made up of distinguished and prominent engineers under the chairmanship of Dr. J. W. Barker, chairman of the Board of the Research Corporation and president of EJC.

Survey Made on Engineering Career Satisfactions

Engineers must change their attitudes if they are to become good managers; opportunity for advancement and the chance to do creative work are rated as the most important job factors by engineers in industry; and three fourths of the engineers in industry feel their education was deficient in certain areas.

These are some of the highlights in a survey on "Career Satisfactions of Professional Engineers in Industry" which was presented at a conference on professional development of young engineers June 7 in conjunction with the annual meeting of the National Society of Professional Engineers (NSPE) in Dallas, Texas.

The survey is the latest in a series of executive research reports made under the sponsorship of the Professional Engineers Conference Board for Industry, in co-operation with the NSPE.

Conducted by the Opinion Research Corporation, Princeton, N. J., the report is based on personal interviews with 265 professional engineers employed in industry throughout the country. The detailed "depth" interviews were designed to bring out the nonsalary career satisfactions of engineers at three stages of professional experience—3 to 6 years, 10 to 15 years, and 20 to 25 years.

The survey questions centered around such things as the engineer outside of his work, the career outlook of professional engineers, satisfaction and frustration on the job, the question of professional status, and the differences in values of the more successful engineers.

Eleven companies, each among the 200 largest corporations in the United States, were represented in the survey. The industries covered were: aircraft, automobile manufacturing, chemical, electronics, electrical machinery, heavy equipment, petroleum refining, and rubber.

The results of the survey will be published in booklet form and distributed throughout industry.

CORRECTION: On page 481 of the June issue of *Electrical Engineering*, the end of the first sentence in the last paragraph of column 1 should read ". . . in the field of narrow band television employing a frequency bandwidth of only 250,000 cycles."

New Officers Elected for San Francisco ESPS

Appointed to participate in personnel placement for engineers, the following representatives of the local sections were elected to fill offices on the San Francisco Advisory Committee for the Engineering Societies Personnel Service (ESPS):

Chairman—B. S. Truett, American Society of Mechanical Engineers, San Francisco district sales manager, American Meter Co.

Vice-Chairman—L. L. Wise, The Engineers' Club of San Francisco, associate editor, *Engineering News Record*.

Secretary—Morris Weitzner, Society of Naval Architects and Marine Engineers, chief engineer, Bethlehem Pacific Coast Shipbuilding Division.

Treasurer—P. M. Ruedrich, American Society of Lubrication Engineers, chemical director, Nopco Chemical Co.

Assistant Secretary—B. L. Raffin, American Society of Civil Engineers, partner, Rothschild, Raffin & Weirick.

Assistant Treasurer—L. A. Norman, American Institute of Mining, Metallurgical and Petroleum Engineers, staff engineer, Equipment Engineers.

Recording Secretary—N. D. Cook, ESPS, manager.

Member—H. N. Skow, AIEE, manager, Pacific Coast Switchgear Division, Westinghouse Electric Corporation.

Associate—J. R. Decker, ESPS, western representative.

COMMITTEE ACTIVITIES

EDITOR'S NOTE: *This department has been created for the convenience of the various AIEE technical committees and will include brief news reports of committee activities. Items for this department, which should be as short as possible, should be forwarded to R. S. Gardner at AIEE Headquarters, 33 West 39th Street, New York 18, N. Y.*

NOTE: Because of the changeover in committee personnel, no items appear in the Committee Activities column this month.

AIEE PERSONALITIES

M. D. Hooven (AM '24, F '44), chief electrical engineer of the Public Service Electric & Gas Co., Newark, N. J., received the honorary degree of doctor of science on June 6, at the 41st commencement exercises of Newark College of Engineering. A past president of AIEE (1955-56), Mr. Hooven was born in Weatherly, Pa., May 30, 1897. He graduated from Bucknell University magna cum laude in 1920. After serving as an engineer with the Westinghouse Electric and Manufacturing Co. and as radio engineer with the Robbins Electric Co., he joined Public Service in 1922. Mr. Hooven is past president of the Montclair Society of Engineers and a member of Eta Kappa Nu. He is a member of the American Society of Mechanical Engineers, National Society of Professional Engineers, and a senior member of the Institute of Radio Engineers. Mr. Hooven also holds membership in the American Society for Engineering Education and is a member of its Committee on Development of Engineering Faculties. He has been active in the Engineers' Council for Professional Development, was vice-president for one year, is current president, and is first chairman and member of the Committee on a Survey of the Engineering Profession. Mr. Hooven was vice-president of AIEE District No. 3, 1952-54. He has served on the following AIEE Committees: Technical Program (1942-47, 1949-50, chairman 1945-47); Board of Directors (1948-52, 1955-56); Planning and Co-ordination (1945-47, 1949-55, chariman 1949-55); Institute Policy (1945-47); Engineers' Council for Professional Development (1948-52, 1953-55); Award of Institute Prizes (chairman 1945-47); Board of Examiners (1948-49); Edison Medal (1948-52, 1956-58); Finance (1950-54); Technical Operations (1952-55); Executive (1952-54, 1955-57, chairman 1955-56); Publication (chairman 1953-55); Public Relations (1953-55); Engineers Joint Council (1954-55).

J. H. Chiles, Jr. (AM '28, F '48), manager of the Transformer Division of the Westinghouse Electric Corporation at Sharon, Pa., has been elected a vice-president of the corporation. Mr. Chiles, who was born in Nashville, Tenn., was graduated from Virginia Polytechnic Institute with a degree in electrical engineering. He joined Westinghouse in 1926 and has spent his entire career at the Transformer Division. He became engineer in charge of the Instrument Transformer Section in 1934, division engineer in charge of instrument and regulator activities in 1943, and engineering manager for the entire division in 1949. Mr. Chiles was appointed manager of the Transformer Division in 1956. Mr. Chiles has served on the following AIEE Committees: Instruments and Measurements (1947-55), Transformers (1947-57), Special Instruments and Auxiliary Apparatus (1956-57).

J. G. Everhart (AM '39, F '51), plant manager of Line Material Industries (L-M) fiber products plant in Sherman, Texas, has been appointed vice-president and general manager of Illinois Edison Porcelain Division, Macomb, Ill., which is operated under the direction of L-M for McGraw-Edison Company. Mr. Everhart joined L-M in 1938 after receiving an electrical engineering degree from Pennsylania State University. In 1948, after holding a succession of engineering posts at the transformer plant in Zanesville, Ohio, he was named chief engineer of L-M's Transformer Division. Early in 1955 he was appointed plant manager of the Sherman, Texas, fiber products plant. He is a member of the American Management Association, and the American Institute of Management. He is also a member of Eta Kappa Nu, Tau Beta Pi, and Sigma Tau, honorary engineering societies.

J. M. Geiger (AM '28, F '50), chief electrical engineer of the system project engineering department, Niagara Mohawk Power Corporation will retire from this position. He will be retained by the company as an engineering consultant. **O. K. Brown** (AM '53), assistant chief electrical engineer, will succeed Mr. Geiger as chief electrical engineer of the department. Mr. Geiger started his utility career in 1910 with the Cataract Power & Conduit Company of Niagara Falls, N. Y. He served in the U. S. Navy in World War I. He has been engineer-in-charge of a number of major electrical engineering projects, including the addition of several generating units and other equipment at Huntley, Oswego, Dunkirk, and Albany Steam Stations, the Seneca Terminal Station, Raquette River Project, and others. He is author of many technical papers. Mr. Geiger has served on the AIEE Switchgear Committee (1948-57). Mr. Brown has been with the company since 1933 when he started as a field engineer. He was graduated from the University of Michigan. An active U. S. Army reservist, he holds the rank of Colonel, Signal Corps, and saw service during World War II. Both men are members of the New York State Society of Professional Engineers.

W. F. Tait, Jr. (AM '27, M '45), vice-president in charge of electric operation of Public Service Electric and Gas Company, Newark, N. J., was elected executive vice-president of the company. **E. H. Snyder** (AM '27, F '49), general manager of the electric department, was elected vice-president in charge of electric operation to succeed Mr. Tait, and **A. R. Nelson** (AM '22, F '55), general superintendent of electric distribution in the company's general office, was named general manager of the electric department, succeeding Mr. Snyder. Mr. Tait, who started with the company as a cadet engineer in 1922 after graduation from Lehigh University, has held various positions in the electric department and in 1948 was named general manager. Two years later he was appointed vice-president in charge of electric operation. Mr. Tait is a director of Public Service Electric and Gas Company and is also a director of the Atomic Power Development Associates, Inc., a research group of which Public Service is a member. Last year he was named to the New Jersey Atomic Energy Study Commission. Mr. Tait is currently president of the New Jersey Utilities Association and is a member of the American Society of Mechanical Engineers. Mr. Snyder has been general manager of the electric department of Public Service since 1950.

Membership in the American Institute of Electrical Engineers, including a subscription to this publication, is open to most electrical engineers. Complete information as to the membership grades, qualifications, and fees may be obtained from Mr. N. S. Hibshman, Secretary, 33 West 39th Street, New York 18, N. Y.

He was graduated from Lehigh University in 1923 and went directly to Public Service as a cadet engineer. Mr. Snyder has served on various committees of the AIEE, American Society of Mechanical Engineers, and the Edison Electric Institute. Mr. Nelson started with Public Service as a cadet engineer in the electric department in 1920 after being graduated from Harvard University. His first assignment as an engineer was in the Southern Division of the company where he became assistant division superintendent of electric distribution in 1930. He was appointed superintendent of the Essex Division electric distribution department in 1940. Mr. Nelson has been general superintendent of electric distribution in the general office of the company since 1949. He has been active in the Harvard Engineering Society.

C. H. LeVee (M '42, F '50), senior electrical engineer, J. G. White Engineering Corporation, New York, N. Y., has been appointed director of engineering, research, and development for Hubbard and Company, and will direct a new and expanded research program for all Hubbard plants. Mr. LeVee joins Hubbard after three years with J. G. White Engineering Corporation, as senior electrical engineer and consultant to the Council for United States Aid in Formosa, China. Prior to his Formosa assignment, Mr. LeVee was vice-president in charge of engineering and construction for Fagan Electric Company, Little Rock, Ark. Earlier he held engineering posts with several electric utility firms and was in charge of utility sales for the wire and cable department, U. S. Rubber Company. During the war he served as an officer with the Seabees in the South Pacific. Mr. LeVee is an electrical engineering graduate of Rensselaer Polytechnic Institute, a member of the National Society of Professional Engineers, and a member of American Military Engineers.

J. V. L. Hogan (AM '11, F '54, Member for Life), president of Hogan Laboratories, Inc., New York, N. Y., has been awarded the honorary degree of doctor of engineering by the Polytechnic Institute of Brooklyn. An early radio amateur, Mr. Hogan was a laboratory assistant to Lee de Forest, in 1906-07. In 1910, after studying electrical engineering at the Sheffield Scientific School of Yale University, Mr. Hogan became a telegraph engineer for the National Electric Signaling Company. He was appointed manager of the company in 1917 when its name was changed to the International Radio Telegraph Company. Mr. Hogan left the firm in 1921 to become a consulting engineer and in 1929 became president of Hogan Laboratories, Inc. Radio Station WQXR (then W2XR) of New York was founded, owned, and operated by Mr. Hogan from 1934 to 1944 when *The New York Times* acquired it. One of the three original founders, he helped to combine the Society of Wireless Telegraph Engineers and the Wireless Institute to form the Institute of Radio Engineers (IRE). In 1920, he became president of the IRE and in 1956 he received the IRE Medal. Author of "The Outline of Radio," Mr. Hogan has contributed through numerous inventions to the radio, television, and facsimile fields. He has served on the following AIEE Committees: Standards (1923-38), Communications (1947-48), and Telegraph Systems (1949-57).

Philip Sporn (AM '20, F '30), president of the American Gas and Electric Co., New York, N. Y., was awarded an honorary doctor of science degree at Ohio State University's commencement on June 7. As president of American Gas and Electric and its subsidiary companies, Mr. Sporn heads a utility system serving 5 million people in parts of seven midwestern and border states. Holder of the John Fritz Medal, he has won national and international recognition for his leadership in developing efficient and economical electric power generation, transmission, and distribution. Mr. Sporn joined American Gas and Electric in 1920, rose to chief engineer in 1933, and its president in 1947. He also is president of the Ohio Valley Electric Corp. formed in 1952 by 15 electric utility companies to build the power facilities for supplying the Atomic Energy Commission's Portsmouth, Ohio, project. A Columbia University engineering graduate, he has received six honorary degrees. Mr. Sporn has served on the following AIEE Committees: Transmission and Distribution (1927-28, 1929-47, chairman 1941-43); Research (1932-36); Production and Application of Light (1933-1934); Power Generation (1933-39); Technical Program (1941-43); Standards (1941-43); Award of Institute Prizes (1942-43); Lamme Medal (1944-47); and Edison Medal (1948-53).

W. R. G. Baker (AM '19, F '47), vice-president of the Electronics Division of the General Electric Company, Syracuse, N. Y., was re-elected president of the Radio-Electronics-Television Manufacturers Association (RETMA) for a second term at the 33rd annual convention of the association. Born in Lockport, N. Y., Dr. Baker is a graduate of Union College. He joined the General Electric Company in 1917. He has been a member of the Board of Directors of RETMA and director of its engineering department since 1934. In 1953, Dr. Baker received the RETMA Medal of Honor for outstanding contributions to the industry. He has served on the following AIEE Committees: Special Committee on Postwar Planning (1943-45); Award of Institute Prizes (1947-48, 1949-52); Electronics (chairman 1945-47); Standards (1945-47); Technical Program (1945-48); Communication and Science Co-ordinating (chairman 1947-48); Planning and Co-ordination (1947-50).

J. E. Hobson (AM '36, F '48), vice-president of the United Fruit Company of Boston, Mass., was awarded an honorary doctor of engineering degree by Purdue University, his alma mater, in ceremonies at Lafayette, Ind., June 2. His citation reads: "In recognition of his achievements and contributions to American technology as a teacher, an engineer, and a pioneering leader in the organization, promotion, and management of educational and industrial research enterprise serving industry, Government, and education." Dr. Hobson was director of Stanford Research Institute for eight years before becoming vice-president of the United Fruit Company. He is a fellow of the Institute of Radio Engineers. He has served on the following AIEE Committees: Basic Sciences (1941-45); Electrochemistry and Electrometallurgy (1943-45); Education (1944-45); Power Transmission and Distribution (1944-47); Standards (1945-50); Communication (1946-47); Registration of Engineers (1946-51, chairman 1947-49); Chemical, Electrochemical, and Electrothermal Applications (1946-53); Research (1947-49, 1954-57, chairman 1955-57); Electronics (1947-57); Professional Group Co-ordinating (1947-49); Instruments and Measurements (1949-55); Liaison Representative on Standards (1952-55); Science and Electronics Division (1953-57); Technical Operations (1955-57); National Research Council (1956-57).

T. F. Hadwin (AM '35, M '35), superintendent of substations, British Columbia Electric Co., Ltd., Vancouver, B. C., Canada, has been appointed district manager of the Bridge River Area. This area with a present installed capacity of one 42,000 kva unit and four 50,000 kva units, is being increased by the addition of one 22,000 kva unit and four 62,500 kva units to a total of 514,000 kva of hydroelectric capacity. Mr. Hadwin is a graduate of the University of British Columbia with postgraduate training at the University of Pittsburgh while associated with the Westinghouse Electric Corporation. He is a registered professional engineer and a member of the Engineering Institute of Canada.

W. G. Darley (M '49), consulting engineer, has announced the relocation of an office. The new address is 164 USAA Building, San Antonio, Texas. Mr. Darley graduated from Texas A & M College in 1930, receiving his B.S. degree at that time. Since graduation he has been initiated into Eta Kappa Nu and Tau Beta Pi. In 1937, he was awarded a professional E.E. degree by Texas A & M; his thesis dealt with Lighting in Grey Goods and Denim Mills. At the 1948 National Conference of the Illuminating Engineering Society, he was honored with the Society's Niagara Award for the paper "An Analysis of Reflected Glare." In 1947, after 17 years with the General Electric Company, Mr. Darley established a consulting practice in Austin, Texas. He is a registered professional engineer in Texas and Ohio, a member of the Texas and National Societies of Professional Engineers, and a fellow of the Illuminating Engineering Society.

L. F. Hunt (AM '21, F '38), consulting engineer, Southern California Edison Company, has been appointed director of electrical engineering for The Ralph M. Parsons Company. Mr. Hunt was born in San Jose, Calif., June 17, 1897. He received the B.S. degree in E.E. in 1919 and the professional E.E. degree in 1929 from the University of Southern California. After graduation, he joined the Westinghouse Electric Corporation. In 1922, he entered the service of the Southern California Edison Company as assistant protection engineer and after holding various positions became chief electrical engineer in 1945. In 1953, he was appointed consulting engineer. Mr. Hunt has invented some 40 devices for the improvement of electric service and is the author of numerous technical articles and papers. In 1940, he was honored by receiving the Modern Pioneer Award. He is a registered electrical and mechanical professional engineer in the State of California. He is a life member of the American Ordnance Association and a member of the Newcomen Society in North America, Sigma Xi, and Eta Kappa Nu. Mr. Hunt is a member of the United States National Committee of International Conference on Large Electric High-Tension Systems (CIGRE). He is a past chairman of the Los Angeles Section of the AIEE. In 1948, he organized The Royal W. Sorensen Fellows of Los Angeles. Mr. Hunt has served on the following AIEE Committees: Protective Devices (1936-37), Sections (1944-45), Special Committee to Review the Practices in the Award of Institute Prizes (1946-47), Transfers (1947-52), and System Engineering (1947-49).

E. I. Shobert, II (M '51), manager of research and engineering, Stackpole Carbon Company, St. Marys, Pa., was awarded the honorary degree of doctor of science at the annual commencement of Susquehanna University, Selinsgrove, Pa. He also delivered the address to the graduates of the University.

W. J. Ellenberger (AM '31, M '38), Colonel, Signal Corps, USAR, has recently transferred from the Office of the Chief of Research and Development, Department of the Army, to the Office of the Chief Chemical Officer, Department of the Army. As supervisory construction management engineer in charge of the Installations Branch, Logistics Planning Division, he will advise and assist the Chief Chemical Officer on matters concerning construction, maintenance of facilities, and real estate as related to Chemical Corps installations. Mr. Ellenberger holds a commission as Colonel, Signal Corps, USAR. He has served on the following AIEE Committees: Industrial Power Systems (1950-57), Liaison Representative on Standards (1953-54), and Management (1955-57).

W. E. Lyons (AM '51), acting general manager for the Capacitor Division of Good-All Electric Manufacturing Company, Ogallala, Nebr., has been named general manager of the Division. Mr. Lyons, formerly from Richmond, Va., is a graduate of the University of Alabama and a member of the American Society for Quality Control, the American Society for Testing Materials, and the Institute of Radio Engineers.

OBITUARIES

Douglass Burnett (AM '93, M '04, Member for Life), retired, died recently at the age of 85. Mr. Burnett was born in Brooklyn, N. Y., on April 6, 1872. He received the B.S. degree in 1890 from Brooklyn Polytechnic Institute. After some graduate work, he became assistant instructor in chemistry at Pratt Institute, Brooklyn, N. Y. In 1894, he was employed by the Edison Electric Illuminating Company—later the New York Edison Company. At this time, Mr. Burnett invented an instrument for measuring illumination. In 1904, he went to Baltimore, Md., where he was employed by the United Electric Light and Power Company and the Consolidated Gas Company. He also served as head of a national rural electrification project. He was an instrumental figure in organizing the first night school in Baltimore. This project was sponsored by the Gas and Electric Company and the Baltimore & Ohio Railroad in co-operation with Johns Hopkins University. Mr. Burnett served for many years as an official of the Baltimore Gas and Electric Company. Because of his pioneer efforts in methods of gas heating, the company was able to bring manufactured gas to many households in the city of Baltimore long before it became a common utility elsewhere. Another contribution was work which led to national standardization on a simplified plan of lamp voltages—three voltages became the rule in place of the former 32 voltages. Mr. Burnett was the author of numerous technical papers. During his career, he served as president of the Engineers Club of Baltimore and vice-president of the New York Electrical Society. He also served as chairman of the Baltimore Section of the AIEE.

Frank A. Cowan (M '29, F '45), assistant director of operations for the long lines department of American Telephone & Telegraph Company, New York, N. Y., died recently at the age of 59. Born in Escatawpa, Ala., Mr. Cowan was graduated from the Georgia Institute of Technology in 1919 with a B.S. degree in E.E. A few months after graduation, he joined the long lines department in Atlanta to begin his career with the Bell System. In 1922, he was transferred to New York. All of his years in the Bell System were devoted to engineering work. Mr. Cowan's interest in scientific activities led to development of varistor type modulators and demodulators, which are widely used today in communication systems. Another of his inventions, first built in his own workshop and now used throughout the Bell System, is a telegraph transmission measuring set. Mr. Cowan also made several trips abroad on communications matters. He was the United States delegate at the meetings of the International Consulting Committee on Telephony in 1946. Mr. Cowan was a fellow of the Institute of Radio Engineers. He had written a number of published papers on telephone subjects and, as a result of his accomplishments, was awarded the 1953 Lamme Medal. The award was for outstanding contributions to long distance communications and development of transmission equipment. Mr. Cowan had served on the AIEE Technical Program and Award of Institute Prizes Committess.

Otto Haentjens (AM '26, Member for Life), president of Barrett Haentjens & Company, Hazleton, Pa., died recently at the age of 78. Mr. Haentjens was born in Mulhein am Rhein, Germany, on October 24, 1879. He received his engineering education at the Konishnish Technich Hochschulle, Charlottenberg, Germany. Before coming to the United States in 1905, he worked in Germany and Sweden. In the United States, he was employed in engineering design work in New York City, Oil City, and Buffalo, after which he became chief design engineer for the Jeanesville Iron Works in Hazleton. Following this, he served as a designer for the Worthington Corporation in Harrison, N. J. In all of these positions, he was engaged in the design of various types of pumps. In 1916, with some men from the Jeanesville Iron Works, Mr. Haentjens founded Barrett Haentjens & Company to supply pumps for the mining industry. He remained president of the company and was active in design work up to the time of his death. Mr. Haentjens held many patents. He was a member of the American Society of Mechanical Engineers and American Institute of Mining, Metallurgical, and Petroleum Engineers.

Thomas J. MacKavanagh (M '13, F '34, Member for Life), professor emeritus of electrical engineering, The Catholic University of America, Washington, D. C., died recently. Born in Bellshill, Scotland, on May 25, 1882, Dr. MacKavanagh studied at the Royal Technical College in Glasgow, Scotland, and at the Nova Scotia Technical College in Halifax, N. S., Canada. Following his formal education, he subsequently held the positions of chief electrical engineer for the Anglo-American Telegraph Company, research engineer for the Shawinigan Water and Power Company in Quebec, assistant professor of electrical engineering at the University of Michigan, and chief electrical engineer for the Potomac Electric Power Company in Washington, D. C. On January 30, 1918, he was appointed professor and head of the department of electrical engineering at The Catholic University. He also served as chairman of the faculty committee on athletics and organized the University's personnel and placement office after World War I. During World War II, he served as chairman of the University's War Training Program. He retired from the faculty in 1952. Dr. MacKavanagh earned the degree of doctor of jurisprudence in 1924 and the degree of doctor of civil law in 1927 from National University. He was a member of the Bar of the Court of Appeals of the District of Columbia, the Bar of the United States Court of Customs and Patent Appeals, and the Bar of the Supreme Court of the United States. He served as chairman of the Washington Section of the AIEE during 1933.

Francis Dale Wyatt (AM '15, M '21, F '49, Member for Life), electrical engineer, Chicago Park District, Chicago, Ill., died recently. Mr. Wyatt was born in Delaware, Ohio, on November 19, 1890. He received the E.E. degree from Ohio State University in 1912. After graduation he worked as a cadet engineer for the Doherty Operating Company. In 1915, he became test engineer for the National Cash Register Company and in 1916 he joined Union Gas and Electric Company as chief electrician. From 1930 to 1940, he served as electrical engineer for the United Light and Power Engineering and Construction Company. In 1940, he became electrical engineer for the Chicago Park District. In this position, he was in charge of design and operation of the electrical systems of the parks within the City of Chicago. Mr. Wyatt was a member of the Illuminating Engineering Society. He served on the AIEE Protective Devices Committee (1927-28).

MEMBERSHIP

Recommended for Transfer

The Board of Examiners at its meeting of June 20, 1957, recommended the following applications for transfer. Any objection to these transfers should be filed at once with the secretary of the Institute. A statement of valid reasons for such objections must be furnished and will be treated as confidential.

To Grade of Member

Baird, P. T., general operations superintendent, Consumers Public Power Dist., Lincoln, Nebr.
Beavers, R. E., assistant engineer, Ohio Bell Telephone Co., Cleveland, Ohio
Becher, J., assistant chief electrical engineer, Burns & Roe, Inc., New York, N.Y.
Best, E. J., electrical engineer, Southwestern Gas & Electric Co., Shreveport, La.
Bonk, J. J., consulting & application engineer, Westinghouse Electric Corp., Philadelphia, Pa.
Chalmers, S. M., senior engineer, Salt River Power District, Phoenix, Ariz.
Charlton, T., advanced engineer, Westinghouse Electric Corp., Lima, Ohio
Clapp, D. E., research director for controls, Proctor Electric Co., Philadelphia, Pa.
Clugston, D. W., unit supervisor, General Electric Co., Erie, Pa.
Coggins, R. L., asst. superintendent, Meter-Relay & Communications Div., Salt River Power District, Phoenix, Ariz.
Corporon, R. P., senior project engineer, Products Div., Bendix Aviation Corp., South Bend, Ind.
Dakin, T. W., manager, physics of insulation section, Westinghouse Research Laboratory, Pittsburgh, Pa.
Daniels, W. L., electrical engineer, United Engineers & Constructors Inc., Philadelphia, Pa.
Deck, J. B., Jr., lighting engineer, Texas Power & Light Co., Dallas, Tex.
Diller, H. N., distribution engineer, Central Illinois Public Service Co., Springfield, Ill.
Downs, C. L., Jr., project engineer, Pennsylvania Power & Light Co., Allentown, Pa.
Edwards, P. J., senior design engineer, Westinghouse Electric Corp., Sunnyvale, Calif.
Ehinger, C. D., president & manager, Citizens Telephone Co., Decatur, Ind.
Esden, R. M., distribution engineer, Central Illinois Public Service Co., Mattoon, Ill.
Esselman, W. H., manager, advanced development & planning, Westinghouse Electric Corp., Pittsburgh, Pa.
Feeley, A. G., project engineer, Lincoln Electric Co., Euclid, Ohio
Fowler, W. H., engineer, Commonwealth Edison Co., Maywood, Ill.
Fox, J. M., electrical engineer, United Engineers & Constructors, Inc., Philadelphia, Pa.
Gaul, J. R., design engineer, industrial motor engg. dept., Westinghouse Electric Corp., Lima, Ohio
Gordon, W. T., section manager, industrial motor engg. dept., Westinghouse Electric Corp., Lima, Ohio
Graham, R. C., chief engineer, Rome Cable Corp., Rome, N.Y.
Gray, C. N., engineer, General Electric Co., Erie, Pa.
Gregg, R. C., electronic engineer, U.S.A. Electronic Proving Ground, Fort Huachuca, Ariz.
Hamer, A. K., electrical engineer, Brockton Edison Co., Brockton, Mass.
Hart, C. M., manager & general superintendent, Citizens Utilities Co., Kingman, Ariz.
Hawkins, G. E., senior engineer, Francis Associates, Marion, Mass.
Holmes, J. F., supervisor private wire operations, Sylvania Electric Products Inc., Camillus, N.Y.
Hornby, F., staff engineer, American Viscose Corp., Meadville, Pa.
Horney, J. C., Jr., great lakes district manager, Sangamo Electric Co., Detroit, Mich.
Hubbard, J. W., division engineer, The Empire District Electric Co., Aurora, Mo.
Huber, R. F., chief engineer, Equipment Div., Joslyn Mfg. & Supply Co., Chicago, Ill.
Huyett, W. I., chief engineer, Polymer Corp., Reading, Pa.
Jacobs, G. B., electrical engineer, General Electric Co., Philadelphia, Pa.
Jones, A. H., engineer, Steward & Stevenson Services, Inc., Houston, Tex.
Jury, E. I., assistant professor, University of California, Berkeley, Calif.
Kerr, F. F., electrical engineer, The Empire District Electric Co., Joplin, Mo.
Kongabel, H. J., Mississippi Valley district manager, Westinghouse Electric Corp., St. Louis, Mo.
Lamb, H. P., vice-pres. & manager, project engineering, Adamson United Co., Akron, Ohio
L'Anglais, F., Tasse, Sarault & Associates, C. E., Quebec City, Que., Canada
Lilly, E. L., senior electrical engineer, Porter, Urquhart, McCreary & O'Brien, Newark, N.J.
Lundelius, O. E., chief electrical engineer, Brown & Root, Inc., Houston, Tex.
MacDonald, C. H., electrical engineer, C. A. Meadows & Associates, Ltd., Toronto, Ont., Canada.
Malaman, G., executive, Edisonvolta, S.P.A., Milan, Italy
Marsolek, M. M., senior engineer, Salt River Power District, Tempe, Ariz.
Mathias, R. A., asst. professor of electrical engg., Carnegie Institute of Technology, Pittsburgh, Pa.
Maxwell, M., electric utility engineer, Westinghouse Electric Corp., East Pittsburgh, Pa.
Mayer, C. J., application engineer, Westinghouse Electric Corp., Williamsport, Pa.
McCaskill, K., electrical engineer, Hooker Electrochemical Co., Niagara Falls, N.Y.
McDuffie, G. L., district manager, Southern States Equipment Corp., Dallas, Tex.
McLean, R. E., electrical engineer, H. A. Sewell and J. A. Sewell, C. E., Spokane, Wash.
Metz, W. L., senior design engineer, Westinghouse Electric Corp., East Pittsburgh, Pa.
Miller, H. D., general manager, City Utilities of Springfield, Mo.
Modi, J. T., engineering executive, The Surat Electricity Co., Ltd., Surat, India
Moore, F. B., asst. professor of engg. extension, Pennsylvania State University, University Park, Pa.
Motl, L. F., chief engineer, Wisconsin Conservation Dept., Madison, Wis.
Noland, J. H., Jr., associate professor of electrical engg., University of South Carolina, Columbia, S.C.
Noon, M. E., supervisor, miniature capacitor engg., General Electric Corp., Hudson Falls, N.Y.
Nordfelt, H. C., Partner, Continental Sales & Engineering Co., Pittsburgh, Pa.
Oertli, F. J., president, Guarantee Electrical Co., St. Louis, Mo.
Orvis, J. B., supervising engineer, The Bell Telephone Co. of Pa., Philadelphia, Pa.
Patterson, J. W., engineer, Philadelphia Electric Co., Philadelphia, Pa.
Petersen, C. C., senior engineer, Motorola, Inc., Phoenix, Ariz.
Piercy, E. W., manager, industrial sales, Canadian Westinghouse Co., Vancouver, B. C., Canada.
Powell, C. A., engineer, Baltimore Gas & Electric Co., Baltimore, Md.
Roehrer, C. R., manager, application engg. dept., The Euclid Electric & Mfg. Co., Madison, Ohio
Rogers, T. D., factory representative, Radio Corp. of America, Merchantville, N.J.
Schmitz, N. L., associate professor of elec. engg., University of Wisconsin, Madison, Wis.
Seeley, H. T., relay application engineer, General Electric Co., Philadelphia, Pa.
Smith, H. R., distribution systems engineer, Rural Electrification Administration, Washington, D.C.
Spencer, D. C., project manager, Westinghouse Electric Corp., Pittsburgh, Pa.
Stone, L. R., project engineer, Steel & Tubes Div., Republic Steel Corp., Cleveland, Ohio
Sullivan, T. P., manufacturing engineer, General Electric Co., Erie, Pa.
Sullivan, W. L., engg. training & personnel supervisor, Southern Bell Tel. & Tel. Co., Atlanta, Ga.
Sultzbach, R. L., group leader, I-T-E Circuit Breaker Co., Philadelphia Pa.
Swicegood, H. L., chief engineer, Brockton Edison Co., Brockton, Mass.
Taylor, E. R., partner, E. R. Taylor & Associates, Tulsa, Okla.
Taylor, J. D., distribution development engineer, B. C. Power Commission, Victoria, B. C., Canada.
Thomas, H. A., engineer, Ohio Bell Telephone Co., Cleveland, Ohio
Thompson, F. W., design engineer, General Electric Co., Hendersonville, N.C.
Thompson, W. G., senior electrical engineer, Sverdrup & Parcel, Inc., St. Louis, Mo.
Turkington, R. E., senior member, Radio Corp. of America, Waltham, Mass.
Valentine, F. B., supervisor of test equipment, Westinghouse Electric Corp., Lima, Ohio
Vanderford, W. E., transmission line engineer, Alabama Power Co., Birmingham, Ala.
Verner, D. R., engineer, Allis-Chalmers Mfg. Co., Pittsburgh, Pa.
Warrick, T. J., supervisor, engineering unit, General Electric Co., Erie, Pa.
Wilkie, D. F., retired, 1826 N. 43rd St., Phoenix, Ariz.
Williamson, R. A., electrical engineer, Tennessee Valley Authority, Chattanooga, Tenn.
Zanskas, A. S., assistant superintendent, substation construction, Wisconsin Power & Light Co., Madison, Wis.
Zimmerman, R. A., distribution engineer, Westinghouse Electric Corp., East Pittsburgh, Pa.

94 to grade of Member

Applications for Election

Applications for admission or re-election to Institute membership in the grade of Member have been received from the following candidates, and any member objecting to election should so notify the Secretary before August 25, 1957, or October 25, 1957, if the applicant resides outside of the United States, Canada, or Mexico.

To Grade of Member

Angier, M. S., branch manager, Westinghouse Electric Corporation, Toledo, Ohio
Barbeau, R. A., development engineer, IBM Corporation, Poughkeepsie, N.Y.
Boesel, W. F., electrical design engineer, The Canadian Westinghouse Co., Ltd., Hamilton, Ont., Canada
Briggs, D. K., assistant superintendent-engineering, Western Electric Co., Winston-Salem, N.C.
Byrne, M. E., protection engineer, Idaho Power Co., Boise, Idaho
Chilberg, G. L., outside plant engineer, American Tel. & Tel. Co., New York, N.Y.
Connelly, M. E., research electrical engineer, Massachusetts Institute of Technology, Cambridge, Mass.
Cox, W. H., design engineer (electrical), Convair, San Diego, Calif.
Eliopolo, J., consulting engineer, 328 Dupont Circle Bldg., Washington, D.C.
Finney, J. A., Jr., project engineer, Thermix Corporation, Greenwich, Conn.
Hassan Saidahmed, H., 16th Khamrawia St., Chubra Cairo, Egypt
Kinnear, G. S., electrical superintendent, Aluminum Co. of Canada, Kitimat, B. C., Canada
Litton, J. W., electrical engineer, Tennessee Eastman Co., Kingsport, Tenn.
Lowy, S. J., engineer, Lowy & Donnath Co., New York, N.Y.
Perry, J., Engineer, Modern Supply Co., Hamilton, Bermuda
Powell, W. M., transformer engineer, General Electric Co., Pittsfield, Mass.
Rowan, J. T., transformer design engineer, General Electric Co., Rome, Ga.
Sandner, C. A., electronic specialist, Lycoming Div. of AVCO Mfg. Corporation, Stratford, Conn.
Scala, A. J., engineer, Lowy & Donnath Co., New York, N.Y.
Smessaert, R. R., chief, product development dept., Teletype Corp., Chicago, Ill.
Sorace, K. J., chief project engineer, The Lamson & Sessions Co., Cleveland, Ohio
Sullivan, H. G., Jr., electrical engineer, Robert & Co. Associates, Atlanta, Ga.
Walker, H. P., electrical engineer, Navy Dept., Bureau of Ships, Washington, D.C.
Wilks, J. H., systems engineer, Canadian Marconi Co., Montreal, Que., Canada

24 to grade of Member

PRELIMINARY EDITION, SUBJECT TO REVISION

NOT FOR PUBLICATION

Report of the Board of Directors

THE BOARD OF DIRECTORS of the American Institute of Electrical Engineers presents to the membership its 73rd Annual Report, covering the fiscal year ending April 30, 1957. It contains a brief summary of the principal activities of the Institute during the year, a general balance sheet showing the financial condition of the Institute at the close of the fiscal year, a statement of cash receipts and disbursements, and a schedule of securities owned. Much additional information regarding the activities appeared in various issues of *Electrical Engineering*.

BOARD OF DIRECTORS' MEETINGS

Five meetings of the Board of Directors were held during the year, two in New York, N.Y., and one each in San Francisco, Calif.; Chicago, Ill.; and Jackson, Miss.

Information regarding many of the more important matters which were considered by the Board of Directors appeared in various issues of *Electrical Engineering*.

ANNUAL MEETING

The 72nd Annual Business Meeting of the Institute was held in San Francisco, Calif., June 25, 1956. A brief abstract of the Annual Report of the Board of Directors for the fiscal year ended April 30, 1956, was presented by Secretary N. S. Hibshman. Treasurer W. J. Barrett gave a report on Institute finances.

The report of the Committee of Tellers on the results of the vote on proposed amendments to the Constitution was read by Secretary Hibshman. All proposed amendments were declared adopted.

Mr. Hibshman presented the report of the Committee of Tellers on the vote of the membership for election of officers whose terms were to begin on August 1, 1956. President Hooven presented a President's badge to President-Elect M. S. Coover who responded by thanking the members for their confidence in him, and gave a brief address on Institute progress.

The Lamme Medal for 1955 was presented to C. R. Hanna, associate director of research, Westinghouse Electric Corporation, East Pittsburgh, Pa.

President Hooven gave an address on "Where We Stand."

GENERAL MEETINGS

Three General Meetings were held during the year, and a brief report on each follows:

Summer and Pacific General Meeting. The 72nd Summer General Meeting, combined with the Pacific General Meeting, was held in San Francisco, Calif., June 25-29, 1956, with a registration of 2,023.

There were 65 technical sessions at which 419 papers were presented; a management session with three papers, a session on safety with three papers, a panel discussion sponsored by the Education Committee on the problems of getting young engineers from college into industry, the Annual Meeting, a session at which District prize-winning papers were presented, a Section Delegates Conference, a Conference of Vice-Presidents and District Secretaries, meeting of the Board of Directors, meetings of many committees, numerous attractive inspection trips, several luncheons with speakers, President's reception and dinner-dance, various entertainment events, and many events for the ladies *(EE, Sept. 1956, pp. 828-36)*.

Fall General Meeting. The 10th Fall General Meeting was held in Chicago, Ill., October 1-5, 1956, with a registration of 2,055. In 39 sessions, 141 papers were presented. In addition, there was a general session, a session on safety, a session on management, six sessions on rotating machinery, a Forum of Technical Committee Chairmen, a session on automation, a meeting of the Board of Directors, a Members-for-Life Fund medal presentation, several luncheons, various committee meetings, many inspection trips, a Fall Frolics (smoker, dinner and dance), and a varied program for the ladies *(EE, Dec. '56, pp. 1108-15)*.

Winter General Meeting. The 45th Winter General Meeting was held in the Hotel Statler, New York, N. Y., January 21-25, 1957, with an attendance of 4,971.

There were 95 sessions at which 389 papers were presented; a general session, a management session, a session on safety, a session on education in electronics, a Forum of Technical Committee Chairmen, transatlantic telephone cable session, a meeting of the Board of Directors, various committee meetings, several luncheons, smoker, dinner-dance, many inspection trips, and many events for the ladies *(EE, Apr. '57, pp. 323-30)*.

DISTRICT MEETINGS

North Eastern District Meeting. A meeting was held in Rochester, N. Y., May 2-4, 1956, with a registration of 351. There was a general session, 11 technical sessions, with 41 papers; sessions on instrumentation, transformers, wireless communication, transmission and distribution, illumination, District Student Prize Paper Contest, dinner-dance, inspection trips, and ladies events *(EE, July '56, pp. 640-43)*

Southern District Meeting. This District held a meeting in Jackson, Miss., April 3-5, 1957, with a registration of 528. The program included 15 sessions at which 68 papers were presented. These sessions included communications, transmission and distribution, metals and insulated cables, computers, transformers, and power generation. Also District Student Branch Competition, meeting of the Board of Directors, luncheons, sightseeing trips, and ladies events *(EE, June '57, pp. 526-28)*.

Great Lakes District Meeting. This meeting was held in Des Moines, Iowa, April 15-17, 1957. The registration was 388. There were 10 sessions at which 33 papers were presented; a general session, sessions on power system stability, magnetic amplifiers, distribution, transmission, District Student Papers Contest, luncheons, inspection trips, banquet, and ladies events *(EE, June '57, pp. 522-23)*.

SPECIAL TECHNICAL CONFERENCES

There were 23 Special Technical Conferences held during the year ending April 30, 1957. There were 13 jointly sponsored in co-operation with other societies. AIEE sponsorship is by the Technical Committees in co-operation with the local Sections. In the aggregate, 17,249 people attended these Conferences and over 650 papers were presented. Brief summary reports follow.

Appliance. The 7th Annual Appliance Technical Conference, sponsored by the Domestic Appliance Subcommittee of the Domestic and Commercial Applications Committee of AIEE, was held at the Wisconsin Hotel, Milwaukee, Wis., May 14-15, 1956, with the Milwaukee Section acting as host. The program was built primarily around the subject of motor-driven appliances. There were 12 papers presented as well as a panel discussion on Test Procedures and Specifications for Motor-Driven Appliances. The Conference was attended by 162 engineers and others. There was an inspection trip to the Milwaukee Hotpoint Plant. No Proceedings were published.

Eastern Joint Computer. This Conference, cosponsored by the AIEE, Institute of Radio Engineers, and Association for Computing Machinery was held at the Hotel New Yorker and Manhattan Center, New York, N. Y., December 10-12, 1956, and attracted 2,600 engineers and others. There were approximately 33 exhibitors showing equipment. During the four sessions which featured new systems, circuits and components, input–output devices, high speed memories, and random-access memory files, 28 technical papers were presented The theme of the Conference was "New Development in Computers." Proceedings were published and may be obtained from any of the sponsoring societies.

Electric Heating. The third Conference on Electric Heating, sponsored by the AIEE Electric Heating Committee and the Toledo Section, was held on April 23-24, 1957, in the Commodore Perry Hotel, Toledo, Ohio. This Conference emphasized the practical rather than the theoretical aspects of industrial heating methods and equipment.

During the sessions 15 papers were presented which included the fundamentals of resistance and of radiant, dielectric, and industrial heating. The Conference closed with four round table discussions on Dielectric Heating, Resistance Heating, Radiant Heating, and Induction Heating. An illustrated, bound booklet of the papers presented was included as part of the registration fee. Additional copies are available at AIEE Headquarters. Registration was 275.

Electric Welding Conference and Exhibit. The Conference and Exhibit were jointly sponsored by the Electric Welding Committee of AIEE and the American Welding Society, and held at the Convention Hall in Philadelphia, Pa., April 8-12, 1957. The Exhibit featured new products, latest developments, money- and time-saving equipment, and live demonstrations of best techniques. The sessions, at which 54 technical papers were presented, covered Nuclear Reactors and Irradiation Effects, Weldability and Research, Applications, Resistance Welding, Structures, Design and Applications, Arc Welding, Titanium and Zirconium, Brazing, Gas-Shielded Welding, Pressure Vessels, and Surfacing, Brazing and Soldering. Dr. C. A. Adams, who founded the American Welding Society, was honored at the show and dinner. The show was renamed "The Adams National Show" and the banquet, "The Adams National Dinner." Both were well attended. There also were tours to the famed Fairless Works of the U. S. Steel Corp., Fairless, Pa. and to the Westinghouse Electric Corp., South Philadelphia Works, Steam Turbine Division. The total number of registrants was 1,839.

Electrical Techniques in Medicine and Biology. The ninth annual Conference on this subject was held at the Sheraton-McAlpin Hotel, New York, N. Y., November 7-9, 1956, jointly sponsored by the AIEE, Institute of Radio Engineers, and the Instrument Society of America. During the four sessions 18 technical papers were presented featuring (1) cardiology, circulation, and resuscitation; (2) electron beam dosimetry; (3) automatic artificial respiration; and (4) explosionproofing and operating room hazards. There was an inspection trip to the Brookhaven National Laboratory, Upton, L. I., N. Y., during which emphasis was placed on radiation protection problems. The program included abstracts of the papers. No Proceedings were published.

There was an evening session during which Dr. Lauriston S. Taylor, National Bureau of Standards, gave a lecture on "The Philosophy Underlying Radiation Protection." The lecture was followed by open discussion from the floor. There was an attendance of 168, including medical men, radiologists, and other technicians.

Electronic Components. The seventh annual Conference on this subject was held in Washington, D. C., May 1-3, 1956. Headquarters was at the Roger Smith Hotel and technical sessions were presented at the Department of Interior Auditorium. The sponsor included AIEE, Institute of Radio Engineers, Radio-Electronics-Television Manufacturers Association, and West Coast Electronic Manufacturers Association, with participation by the agencies of the Department of Defense and the National Bureau of Standards. During the six sessions, 36 technical papers were presented which included Progress with Materials, Theory and Operating Principles, Instruments and Measurements, Electron Tubes and Solid-State Devices, Passive Components I, and Passive Components II. The general session featured a welcoming address by A. W. Rogers, chairman of the Symposium Committee. An interesting paper was written by G. W. Dummer of the Radar Research Establishment, Malvern, England, and presented by C. E. Richards, which outlined some of the recent British developments in electronic components. The symposium was attended by 715 persons. Proceedings were published.

Engineering Management. This Conference was jointly sponsored by the AIEE and the American Society of Mechanical Engineers, and held in the Penn-Sheraton Hotel, Pittsburgh, Pa., March 27-28, 1957. It was devoted to engineering management controls. The program included sessions on control through organization, control through management development, control through electronic data processing, and control of engineering effort in research and development. There was a luncheon on Thursday at which H. Thomas Hallowell, Jr., president, American Standards Association, was the guest speaker. His subject was "Standardization—An Aid to Management Control." No Proceedings were published. The attendance was about 250.

Farm Electrification. The second Conference on Farm Electrification, sponsored by the AIEE subcommittee of the same name, was held in Memphis, Tenn., at the Peabody Hotel, October 29-31, 1956. The total attendance was something over 160, with representatives from 26 states. The program dealt with supply, distribution, and promotion of electric power for farm use. There were 15 technical papers presented. The subjects included large farm motors, electric grounding in rural structures, irrigation equipment, and education in the use of electricity on the farm. The Conference opened with a paper on the little-known subject "The Role that Light and Radiation Plays in Agriculture," and ended with a look into the future with "Electric Service Unlimited for the Farms of Tomorrow." An interesting feature of the meeting was an inspection trip to several electrically operated farms, including one of the largest and most progressive farms of the South. No Proceedings were published; however, individual papers were sold at the Conference.

Industrial Electronics. Attendance at the two-day meeting, jointly sponsored by AIEE and IRE, was approximately 250. It was held at the Hotel Manger, Cleveland, Ohio, on September 24-25, 1956. There were 16 papers presented covering electronic equipment design; automatic production of electronic equipment; electronic testing, gauging, and process control; and electronic data reduction and analysis. Gen. B. W. Chidlaw, former U. S. Air Defense Chief, spoke at the luncheon on the subject "Electronics in Air Defense and Air Offense." No Proceedings were published.

Machine Tool. The 8th Annual Conference on Machine Tools was held at the Sheraton-Gibson Hotel, Cincinnati, Ohio, October 22-24, 1956. It was sponsored by the Machine Tool Subcommittee of the General Industry Applications Committee, and the Cincinnati Section of AIEE acted as host. The attendance totaled 692—which included representatives from England, Canada, the West Coast, as well as most of the major industrial parts of the United States. Short abstracts of the 13 papers presented were included in the program. A panel discussion on New Developments in Static Control Elements was held on the afternoon of the first day with varied experiences covering many phases of the static control field such as static switching, magnetic amplifiers, silicon rectifiers, transistor applications, ignitron contactors, latest research and development studies. One of the highlights of the meeting was the presentation of a citation to Tell Berna, executive vice-president of the National Machine Tool Builders Association for his work in fostering progress in the electrification of machine tools. Plant visitations included Allis-Chalmers Manufacturing Co., the G. A. Grey Company, and the Cincinnati Milling Machine Co. No Proceedings were published.

Magnetism and Magnetic Materials. The second Conference on this subject was held October 16-18, 1956, at the Hotel Statler, Boston, Mass. It was sponsored by the AIEE, in co-operation with the American Physical Society, the American Institute of Mining, Metallurgical, and Petroleum Engineers, and the Institute of Radio Engineers. The attendance totaled 1,096 and the number of companies participating in the exhibit was 15. There was a total of 77 papers presented during the eight sessions which covered topics of magnetic anisotropy, permanent magnets and fine particles, magnetism and physical metallurgy, apparatus and design, losses in soft magnetic materials, ferrites, high-frequency phenomena, and memory devices and magnetic amplifiers. Abstracts of the papers were included in the program. The program covered three major achievements in magnetic research, (1) "Exchange Interaction" between ferromagnetic and antiferromagnetic materials; (2) development of fine particle cobalt–iron permanent magnets with properties comparable to the Alnicos; and (3) development of an 11 million gauss-oersteds energy Alnico magnet—the highest energy ever achieved. Proceedings were published.

Mid-Atlantic Textile. The 1957 Mid-Atlantic Conference on Electrical Application for the Textile Industry, sponsored by the AIEE Textile Industry Subcommittee of the General Industry Applications Committee, was held in Raleigh, N. C., November 1-2, 1956, at the Riddick Laboratories Auditorium, School of Engineering, North Carolina State College. The North Carolina Section acted as host to the Conference. There were three sessions with a total of 11 technical papers presented, featuring outstanding speakers on electric equipment and applications. The technical sessions ended with a panel discussion in which the audience participated. This is a regular part of the Mid-Atlantic Textile Conference. It covers subjects of wide scope in which solutions are offered by the panel to problems presented. Approximately 250 attended this meeting which included those in the textile mills, either in design, application, installation, or maintenance of electric equipment. A social hour was given at the Sir Walter Hotel, followed by a buffet dinner. Other activities included tours of the School of Textiles and the School of Engineering of the North Carolina State College. No Proceedings were published.

National Electronics. The AIEE acted again as a cosponsor of the National Electronics Conference. AIEE papers featured subjects on instrumentation, magnetic amplifiers, solid-state devices, and applications, and were authorized for *Transactions* in the usual way. A total of over 100 papers were presented which covered research, development, and application. There was also an exhibit consisting of over 240 booths. The Conference was held at the Sherman Hotel, Chicago, Ill., October 1-3, 1956, concurrently with the AIEE Fall General Meeting at the Morrison Hotel, so that interested members could attend some of the sessions at each meeting. Approximately 10,000 attended this Conference. During this Conference, approximately 50 chairmen of AIEE and IRE Student Branches from engineering schools in 13 Midwest states, were invited to be guests of the Conference. The object of this program was to provide the students with some insight into the extent of the electronics industry, technical programs, commercial exhibits, education, and technical society endeavors. It was also decided to give a fellowship which would provide $2,500 to pursue graduate work in any one of the universities associated with NEC.

National Telemetering. A two-day Conference, jointly sponsored by AIEE, Institute of Radio Engineers, Institute of Aeronautical Sciences, and Instrument Society of America was held at the Biltmore Hotel, Los Angeles, Calif., August 20-21, 1956. The program, including 26 technical papers, covered sessions on systems, data processing, components and equipment, and recorders; with a panel discussion Monday evening on "Crowding of the Telemetering Frequency Bands," followed by a banquet which was addressed by Dr. E. R. Piore, vice-president for research, Avco Manufacturing Corporation. His subject was "Telemetering and Point Readings." There was a luncheon on the second day at which Professor L. L. Rauch of the University of Michigan and Ramo-Wooldridge Corporation spoke on "Ballistic Missile Telemetry." The Conference was attended by 758 persons. Proceedings were published.

Nuclear Congress. The 1957 Nuclear Congress and Exhibit was held in Philadelphia, Pa., March 11-15, with sessions at the Philadelphia Coliseum, under the co-ordination of EJC, on behalf of 20 engineering and technical societies, including AIEE. More than 40 major topics were presented at the Congress which included nuclear generating stations, reactors for ship propulsion, disposal of radioactive wastes, production of atomic fuels, legislative and legal problems, atomic energy developments abroad, and practical, commercial applications of the atom in such fields as chemical production and food processing. The technical sessions were attended by approximately 3,000 people. The Exhibit featuring nuclear equipment was represented by 122 exhibitors and attended by approximately 8,000 (which included the technical sessions and exhibits). Preprints of numbered papers were available from EJC.

Petroleum Industry. This Conference, sponsored by the AIEE Petroleum Industry Committee and the Kansas City Section, was held at the Muehlebach Hotel in Kansas City, Mo., on September 17-19, 1956. Approximately 380 registered at the Conference including some from Canada and Venezuela. The sessions covered refining, production, and transportation, with 25 technical papers presented. There were two reports, one on "Recommended Standards for Device Numbers and Functions for Pipeline Pump Stations under Automatic or Remote Control," and the other on "Progress to Date on an Electrical Operator for Throttle Valves." Six papers were presented at a symposium on the last day, and a most interesting and timely address on conditions affecting the oil companies operating in the Middle East was presented by M. K. Neptune, general manager of the Sahara Petroleum Company, of Egypt. There were 17 papers preprinted and sold at the Conference. There were six field trips which were well attended. No Proceedings were published.

Pulp and Paper Industry. The Pulp and Paper Subcommittee of the General Industry Applications Committee sponsored a Conference on Electrical Engineering as Applied to the Pulp and Paper Industry, which was held at the Engineering Extension Division of Georgia Institute of Technology, Atlanta, Ga., March 28-29, 1957. Six papers were presented during the two sessions and a panel discussion on Application of Switchgear was held on the first afternoon of the Conference. A social hour and banquet was given at the Atlanta Athletic Club with R. L. Dodd, athletic director of Georgia Tech, as the speaker. The papers covered New Techniques in Preparing Control Diagrams as Recommended by NEMA, Maintenance of Electronic Equipment in a Paper Mill, Report on Conduit Life Tests in Paper Mill Locations, Problems of Switchgear Applications to Pulp and Paper Mills, Lighting in the Pulp and Paper Industry, Cathodic Protection in Pulp and Paper Mills, and Silicon Rectifiers—Power in a Nutshell. There was also an inspection trip to the Georgia Tech Computer Center. More than 125 people attended the Conference. No Proceedings were published.

Recording and Controlling Instruments. This second Conference sponsored by the Recording and Controlling Instruments Subcommittee of the Instruments and Measurements Committee of AIEE, was held in Boston, Mass., at the Bradford Hotel, April 26-27, 1956. The theme of the Conference was "New Developments in Instrumentation for Industrial Control." Approximately 400 attended and 19 papers were presented. The four sessions included: information display and recording, automatic data handling systems, advanced instrumentation systems in industry, and controlled systems for industry. Proceedings were published.

Reliability and Quality Control in Electronics. The 3rd National Symposium on Reliability and Quality Control in Electronics was held in Washington, D. C., at the Statler Hotel, January 14-16, 1957, and was cosponsored by AIEE, Institute of Radio Engineers, Radio-Electronics-Television Manufacturers Association, and American Society for Quality Control. The Conference was attended by 1,200 people which included 19 nonresidents of the United States. There were 30 technical papers presented and the subjects of the sessions included mathematical and advanced theory; trends in airborne equipment reliability; principles for design and management of reliability programs; system reliability analysis; quality acceptance practices; commercial electronics reliability; reliability reports; reliability of component parts; quality control in production; techniques for reliable design; and basic definitions used in reliability; 3 panel sessions, 6 tours, and a total of 65 speakers. The 1,000 persons who attended the banquet heard Dr. D. E. Noble, vice-president of Motorola, Inc., speak on "Master Formulations and the Professor Factor," wherein he expounded on the fantasy of the space man with an unreliable space ship.

Rubber and Plastics. The ninth Conference on Rubber and Plastics was held in Akron, Ohio, at the Mayflower Hotel, April 8-9, 1957. It was sponsored by the AIEE Rubber and Plastics Industry Subcommittee of the General Industry Applications Committee. Nine papers were presented during the eight sessions, with a cocktail hour and banquet held on the first evening, including an address by M. F. Gigliotte of Monsanto Chemical Co., on the subject, "Plastics as an Engineering Material of Construction." The Akron Section acted as host. Proceedings will be published. There were 300 registered at the Conference.

Southern Textile. The 1957 Conference on Electrical Application for the Textile Industry, held March 7-8, at Georgia Institute of Technology, Atlanta, Ga., was sponsored by the Textile Subcommittee of the General Industry Applications Committee of AIEE in co-operation with The A. French Textile School of Electrical Engineering and The Engineering Extension Division of Georgia Institute of Technology. Attendance at the Conference included 144 engineers and others. There were nine papers presented at this Conference with a panel discussion on the last day covering the subject "What Is Your Problem?" No Proceedings were published.

Transistor and Solid-State Circuits. This Conference was held February 14 and 15, 1957, at the University of Pennsylvania, Philadelphia, Pa., and was jointly sponsored by the Science and Electronics Division of AIEE, the Philadelphia Section of IRE, the IRE Professional Group on Circuit Theory, and the University of Pennsylvania. The program included information on both linear and nonlinear transistor circuits. One session was devoted to other solid-state circuits including ferroelectrics and magnet cores, and also two tutorial sessions. No Proceedings were published, but a technical addendum to the program booklet containing reproduction of all slides with mathematical expressions was available. Headquarters hotel was the Bellevue-Stratford. There was a cocktail buffet at the Bellevue-Stratford on the first day, followed by informal group discussions.

Western Joint Computer. This Conference, jointly sponsored by AIEE, the Institute of Radio Engineers, and the Association for Computing Machinery, was held at the Hotel Statler, Los Angeles, Calif., February 26-28, 1957. Inspection trips held included visits to Jet Propulsion Laboratory, Electro Data Corporation, Ramo-Wooldridge Corporation, University of California at Los Angeles, Telemeter Magnetics, Inc., Litton Industries, Rand Corporation, and National Cash Register Company. During the 10 sessions, 36 papers were presented covering Mathematics of Reliability, New Systems *A*, New Components, Applications of Reliability Principles, Component Reliability, Analog Computer Equipment, New Systems *B*, Programming for Reliability, Systems Reliability, and Programming. A Conference cocktail party was held on Tuesday evening, and a luncheon was scheduled for Thursday afternoon. The Los Angeles Chapter of the ACM sponsored a symposium on Friday which covered the subject of "New Computers—A Report from the Manufacturers." Approximately 1,400 attended the Conference. A Proceedings booklet was published.

Committees Reporting to the Board

FINANCE COMMITTEE

The Finance Committee has completed the annual budget of the AIEE as required and has supervised the investment and expenditure of the Institute's funds and the financial operation of Headquarters during the year. In addition to preparing the annual budget on the traditional basis by functions, the budgets have been prepared for the first time on an organizational basis by Department.

The gross income for the fiscal year ending April 30, 1957, exceeded $1 million, the highest in the history of the Institute. The market value of security holdings as of March 29, 1957, was $1,322,350. Current return on these holdings is 3.56%.

The Finance Committee has reviewed the practices of the Institute in managing expenditures and investments and will include recommendations in its final report to the Board on June 28, 1957. The recommendations are directed toward maximizing earnings from operations and investments to provide more funds for Committee and Sections activities and for Headquarters services; they are also directed toward reducing excess cash working funds, increasing yield on invested funds, and increasing capital gains while providing for safety and marketability of securities.

Consolidation of the special funds with the reserve capital fund in order to provide greater diversification, safety, and earnings for the former will be recommended. An increased Group Life Insurance Plan for the Institute's employees was recommended to the Board and put into effect. In addition, this allowed the Retired Employees Insurance Fund to be discontinued and transferred to the reserve capital fund.

Acting for the Board of Directors, salaries of all employees were reviewed and adjusted with recognition of merit and prevailing scales.

The Life Membership Fund which has become unnecessary (since the discontinuance some years ago of single payment dues for life) was discontinued and transferred to the reserve capital fund.

A plan for providing Group Accident, Hospital, and Medical Insurance for the Institute's members and employees was studied and recommended to the Board. The Board directed that the studies be continued.

Securities sold during the year amounted to $47,259, and purchases totaled $279,006, including the investment of $202,275 transferred during the year from the operating fund to the reserve capital fund.

The removal of the editorial offices from Fifth Avenue to the Headquarters building, and other enlargements of the Headquarters office space were accomplished.

Space was provided and prepared for the installation of automatic business machines for processing of dues, bills, other billings, and mailings. Punched cards will make it possible to run the membership by various classifications and will make available information not readily obtainable heretofore.

The records and accounts of the Institute have been examined in detail, audited, and summarized. Exhibits showing the balance sheet, statement of operating income and expenses, and statement of investment funds and securities owned, as of the close of the fiscal year will be found at the end of this report.

The Headquarters personnel associated with the work of the Finance Committee has served the AIEE effectively during the year with particular progress in advancing the procedures and tools used in the conduct of business affairs.

Representatives of the Institute were entertained by the officers of the First National City Bank of New York in recognition of the fiftieth anniversary of the opening of the AIEE account at the Bank.

For the final report of the Finance Committee, performance data for investments of other organizations and funds have been prepared for the information of the Board of Directors, together with performance data for AIEE investments. Recommendations for investment policies are being studied.

CONSTITUTION AND BYLAWS COMMITTEE

The activities of the Constitution and Bylaws Committee (C & B) continued the fast pace of last year unabated, not only because of the new format of the Constitution and Bylaws under composition, but also because of organization changes in the Institute management which required implementation in the Bylaws.

First, the C & B Committee points with pride to the 1956-57 Organizational Manual (OM) which introduces in print, for the first time, the new-style format of the Bylaws, where the embossed title of each paragraph makes it relatively easy for even those unfamiliar with the Bylaws to locate quickly the desired statutes. The ease with which this is done exceeds the expectation of the committee and in itself is an endorsement and encouragement to complete this work.

During the year, the Bylaws have had comprehensive editorial changes to conform to the new departmental organization of the AIEE designed to relieve the Board of Directors of operational duties as much as possible. Heretofore, all operating committees reported direct to the Board of Directors but now report to and through their respective Department. The Bylaws have thus been implemented to put emphasis on organizational procedure, wherein each committee shall be responsible to the next higher committee or group in the organizational chain. The tabulation of Committees and Departments under B71 are such as to indicate the chain of responsibilities of the operating groups of the Institute.

The five new Departments required corresponding new statutes covering their scope of duties and were written and incorporated in the 1956-57 OM, with little or no delay, to give the membership this tangible evidence of the new departmental organization at the earliest possible time.

In the meantime, work on the new-style Constitution has continued and the first draft is completed and in the hands of the Committee for review, and also this same work is now well advanced into the Bylaws—following the same pattern now to be seen in the 1956-57 OM. The order of procedure is: (1) correct for contents, (2) correct for English and choice of words, (3) review for transfer of details from the Constitution to Bylaws as seem advisable, and (4) last, but not least, adoption of a perpetual numbering system. This could be called a four-point program, the last two of which can be done only after the first two have been completed for both the Constitution and Bylaws.

Considering the fact that the C & B Committee must keep the current Constitution and Bylaws in a working condition, as current changes are proposed and approved, this report can close with the words which it began, the work of the C & B Committee continues unabated.

PLANNING AND COORDINATION COMMITTEE

A meeting of the Committee was held in New York, July 26, 1956, and three more were scheduled during the administrative year: Chicago, October 10; New York, January 24, 1957; and Montreal, June 27.

The work of the Committee has centered on the following assignments:

General and District Meeting Schedules. This assignment was transferred to the Technical Operations Department, in accordance with the 1956-57 reorganization.

Redistricting the Institute. The Committee prepared a "Delineation of Territories," consisting of District maps and list of states and counties in each Section, which was published in the Institute's "Organization Manual for 1956-57."

Under the local option plan of self-division, District 4 voted to divide into Eastern and Western halves, effective August 1, 1958, thereby increasing the number of AIEE Districts to 12.

This assignment has been transferred to the Administration Department.

Ballot for Institute Officers. The Committee again recommended procedural changes which would eliminate a written ballot in cases of "no contest." The Directors did not approve the recommendation.

Organization and Finance. The work of the Committee was devoted principally to this assignment. The three reports of Stevenson, Jordan and Harrison, management consultants, were studied, and a new Departmental plan of organization recommended to the Board of Directors at its meeting on April 3, 1956. The Directors rejected the plan in its original form, but approved a modification of the plan submitted by the Committee at the Director's meeting on June 29, 1956. The new organization was reported to the membership in an article titled, "Committees Reorganized Under Five New Departments," *Electrical Engineering*, September 1956, pp. 857-9. An Organization Chart accompanied the article.

Adoption of the new organization did not mark completion of this assignment. The Committee has guided implementation of the plan, and is studying its effects with a view to suggesting improvements as the need develops.

See report under related assignment, "Expansion of Administration Department."

Membership Opinion Research. The Board of Directors previously authorized a canvass of membership opinion in the field of technical activities; funds to be appropriated by the Committee. This assignment, in effect, has been transferred to the Technical Operations Department, which would conduct the survey.

Electrical Exhibits. Having cleared the path, policywise, for the sponsorship of electrical exhibits at Institute meetings, the Committee voted that initiation of exhibitions, if any, should be the prerogative of the Technical Operations Department.

Registration Fees. The Committee has under consideration a recommendation from the Technical Operations Department that registration fees to members of other cognate societies be reduced.

Recognition for Institute Service. The Committee, in concurrence with the Prize Awards Committee, recommended that certificates be awarded to retiring Officers and Committee Chairmen, effective July 31, 1956. The Board approved the recommendation, adding Subsection Chairmen to the list of prospective recipients.

Recommendation for Fellow Grade. The Committee recommended and the Directors approved no change in the handling of proposals for Fellow grade, but referral of any contemplated changes in the qualifications or methods of election to the Professional Development and Recognition Department for its consideration before action is taken.

Qualifications for Fellow and President. The Committee has referred the study of present requirements of the Constitution and Bylaws to the Professional Development and Recognition Department, asking their recommendations as to whether any changes should be considered.

Indoctrination of Officers. Suggestions originating at the 1956 Summer Conference of Vice-Presidents and District Secretaries were reviewed by the Committee, and the Directors approved recommendations that: (1) the Conference of Vice-Presidents and District Secretaries be held during the Summer General Meeting; (2) a Conference of Vice-Presidents only be held prior to the August Board of Directors meeting; (3) Board of Directors' communications be sent to those on the slate of the Nominating Committee beginning April 1st; (4) incoming Vice-Presidents be advised to work with outgoing Vice-Presidents immediately following the April Board of Directors meeting; and (5) the Conference of Vice-Presidents and District Secretaries be made more useful to the incoming Vice-Presidents by inclusion of specific instruction, and preparation of an agenda.

Expansion of Administration Department. The Board of Directors asked the Committee to consider the desirability of merging the Districts and Sections organization with the Administration Department. The Committee recommended merger of the two groups and offered a revised organization plan aimed at improved operation of the Departments. The Board has not taken action regarding these recommendations.

Committee Meeting Schedule at General Meetings. A pattern for scheduling Committee meetings at General Meetings was submitted to and approved by the Board with minor modifications. The guide is intended to minimize conflicts and provide for effective sequence of meetings of General and Technical Committees, Departments, Technical Divisions; and Conferences of Vice-Presidents and District Secretaries, and Section Delegates.

Schedule of Directors' Meetings. The Committee is studying the possibility of reducing the number of meetings of the Board of Directors held each year.

Amendment of Constitution and Bylaws. As requested by the Directors, the Committee is examining present methods of amending the Constitution and Bylaws to determine whether any change in policy should be proposed.

Assignment of Intersociety Representatives. At the Directors' request, the Committee is considering whether, in the light of a year's experience under the new organization, intersociety representatives should be reassigned among the Departments.

Bylaws of Medal Committees. The Committee has been asked by the Directors to determine whether, and to what extent, authority may appropriately be delegated to the Professional Development and Recognition Department to approve Bylaws or rules of operation of present and future medal committees.

DEPARTMENTS

Administration Department

Sections. The Sections Committee under the chairmanship of Dixon Lewis has done an excellent promotion and guidance job throughout the year.

Technical Groups. The primary project of the Administration Department for the Institute fiscal year was the initiation of a program of organization of new Technical Groups in the Sections. Corollary to this primary objective was the establishment of lines of communication between all Section Technical Groups and the corresponding Institute Technical Committees.

The organization of new Technical Groups was initiated by a postcard survey to all Institute members in the continental United States, Canada, and Mexico, which survey was conducted under the direction of the Sections Committee.

The establishment of lines of communication between the Section Technical Groups and the Institute Technical Committees is being developed as a co-operative activity of the Administration Department and the Technical Operations Department. To assist in accomplishing this objective, the Administration Department recommended, and the Board of Directors approved, the appointment of a representative of the Technical Operations Department as a member of each of the Institute District Executive Committees.

As a result of the postcard survey and the follow-up by the Sections Committee and District Vice-Presidents, it is estimated that approximately 100 technical groups will be organized in the Sections during this and the 1957-1958 Institute years.

Standards for Subsections. In accordance with a recommendation of the Sections Committee, the Administration Department approved standards for the operation of Subsections.

Appointment of Sections Committee Representatives on District Executive Committees. As recommended by the Sections Committee, the Administration Department approved an avenue of appointment of Sections Committee representatives on District Executive Committees. This is now accomplished by the appointment by the Chairman of the Sections Committee upon recommendation by the District Vice-President.

Study of District Executive Committees. A Subcommittee was established in the Administration Department under the chairmanship of Professor Seeley to study the present organization of District Executive Committees and to develop recommendations for the optimum composition of these Committees.

Public Relations. The Administration Department has been particularly appreciative of the fine work of the Public Relations Committee under the chairmanship of Fischer Black.

Inter-Society Representation. A Subcommittee of the Administration Department is studying the problem of inter-society representation and will present a report for submission to the Board of Directors at the 1957 Summer General Meeting in Montreal.

Redistricting. The Administration Department has been studying the subject of Revision of District Lines. There are pending, at present, several suggested changes in boundary lines of Districts 1, 2, 4, 5, 7, and 11.

Correlation of Activities of the Administration Department with Vice-Presidents. One of the problems of the Administration Department during the past year has been the correlation of its activities with the activities of the District Vice-Presidents.

Under the present organization, no channels are provided for the necessary communications between these two operating elements. The Administration Department has made recommendations for the establishment of such lines of communication or a merger of the two organizations. This will be the subject of further recommendation at the June 1957 Board of Directors meeting.

PUBLIC RELATIONS COMMITTEE

The Public Relations (PR) Committee's plans, projects, and activities for the past year reveal a substantial measure of advancement and fulfillment. Many new major projects have been completed, are well under way, or are being initiated. This progress has been made while the existing basic PR program has been kept at a full head of steam.

Considerable PR service was given to other Institute committees, particularly in the preparation of new literature, revamping of booklets that have been in existence for some time, and in layout and printing assistance. It also marked aggressive steps by the Institute to keep members informed about AIEE policies, objectives, and events, while pursuing a vigorous membership and manpower campaign. In all of these your PR Committee had a hand.

It was also a year of considerable self study, not only by the Institute, but by the PR Committee as well. While the Institute was attempting to ascertain member attitudes and wishes, the PR Committee sought to find out how Section PR Committees could be served better and their attitudes toward better public relations. Two PR Workshops were held during Sections meetings.

One of the major undertakings of the PR Committee, in its plans to give AIEE membership a broader understanding of the Institute and its accomplishments, was the preparation of the illustrated brochure "AIEE Today," which told succinctly and graphically what the Institute had been doing in the 1955-56 year. For the most part, the text was based on the Annual Report of the Board of Directors. Copies were made available to members and to Membership Committees. Reaction to this new venture, on the whole, was excellent, and it is recommended that it become an annual activity.

Another project along the same line was the inauguration of a periodic President's Letter to the Section Chairmen, and a similar letter published in *Electrical Engineering*. These aimed at keeping membership currently informed about actions of the Board of Directors, the progress of membership, finance, and other Institute activities.

Still another new PR step calculated to give "read and run" information about the Institute, and at the same time attract new members, was the construction of a three-dimensional AIEE exhibit for use at AIEE meetings and gatherings of other societies attended largely by engineers. This visual education display not only headlines statistical information about AIEE and its technical functions, but also displays the various Institute publications and membership literature. The exhibit was first used at the National Electronics Conference at Chicago, Fall 1956. The response to it was immediate and enthusiastic. It also was used at the Computer Conference in New York, the AIEE Winter General Meeting, and the Nuclear Engineering and Science Congress in Philadelphia. The latest request for the booth was from the West Coast Electronics Exposition in San Francisco for August 1957.

During the year, AIEE National Committees called on the PR Committee for cooperative assistance in their promotional activities. Projects for these committees included layout and printing of the Section Operations Manual, a new and comprehensive guide written by the Sections Committee; writing, layout, and printing of "The College Year," designed as a guide for Student Members; writing, layout, and printing of a new Practical Guide for Membership Committees, and a new "Membership Information Booklet." An initial draft of a revised edition of "The Electrical Engineer" has been written. This booklet is calculated to give youngsters a quick review of the advantages of following a career in the electrical engineering profession.

The year 1956-57 offered several exceptional opportunities to promote electrical engineering. It was, for instance, the 100th Anniversary of the birth of Nikola Tesla. This was widely publicized in the nation's press and in the electrical trade press. It was the theme of the AIEE Fall General Meeting in Chicago and was a feature of the 1957 Winter General Meeting in New York. The PR Committee played a major role in marking this anniversary. There were many special newspaper and feature articles on Tesla prepared by the PR Committee.

On Labor Day, the Mutual Broadcasting System devoted numerous spots to the role of engineers in today's world. Four Institute members, President M. S. Coover, Ex-President M. D. Hooven, Fischer Black, chairman of the AIEE Public Relations Committee, and G. T. Minasian, past AIEE PR chairman, were heard over a nationwide broadcast, using scripts prepared by the PR Committee.

In an effort to find out how Section PR Committees were operating and what their needs are, a questionnaire was sent to all Section PR Chairmen. Replies indicated that although vigorous PR activities are being undertaken by many Sections, this field needs greater cultivation, and, perhaps, should be the focal point of emphasis in PR programs for the next few years. To date, there are 86 Sections which have PR Chairmen and Committees.

It is good to report that excellent publicity results were obtained at the Summer, Fall, and Winter General Meetings and at the Southwestern District Meeting in Dallas, Texas, all of which were attended by the professional representatives of the PR Committee. Good reports also came from the Great Lakes and North Eastern District Meetings at Fort Wayne and Rochester, N. Y.

PR representatives (Raymond C. Mayer & Associates) worked on the Southern District Meeting, Jackson, Miss.; the Great Lakes Meeting, Des Moines, Iowa; the joint Middle Eastern and East Central Districts Meeting at Dayton, Ohio; and the North Eastern District Meeting, Pittsfield, Mass.

Publicity Kits and other PR tools have been furnished to the majority of the 109 Sections. Three Publicity Newsletters have been sent to them, as well as a new tool, "AIEE Awards," a guide to better publicity and public relations in the presentation of awards of appreciation to former presidents, vice-presidents, committee chairmen, and other officers.

Two Public Relations Workshops were held during the year, at the Summer and the Winter General Meetings. These were well attended and produced much interest in more recognition for the profession and electrical engineers.

Two thousand copies of the newspaper matrix feature, "Electrically Speaking," designed to point up the accomplishments of the profession, were furnished daily papers and weeklies throughout the country. These were used extensively by hundreds of newspapers. A radio script on electrical engineering accomplishments was supplied radio stations throughout the country. More than 200 stations reported that they used the script. Many of them commented favorably and asked for more material.

One instance of the measurable effect of publicity stories is the matter of the revised editions of the "Red Book" and the "Green Book," entitled "Electric Power Distribution for Industrial Plants," and "Grounding of Industrial Power Systems." Largely as a result of trade press publicity, these books have had excellent sale.

In conclusion, the PR Committee feels that it has been an excellent and rewarding year, and that results indicate that we are proceeding in the right direction, with more and more Sections and more and more individual members of the Institute awake to the necessity of a vigorous and continuing PR program.

SECTIONS COMMITTEE

The Sections Committee met in San Francisco, Calif., on June 25, 1956, and conducted the annual Section Delegates Conference on June 26. A second meeting of the Sections Committee was held in New York, N. Y., on January 21, 1957, followed by an all-day informal Section Representatives meeting on January 22. The Committee reports substantial progress in the many fields relating to Section activity, briefly summarized as follows:

New Sections. The Victoria Section, covering Victoria Island in British Columbia, Canada, was recognized in October 1956 as the 110th Section. In April 1957 the Gem State Section in southern Idaho became the 111th Section of AIEE. Several new Subsections were organized during the year, reflecting the growth in total membership and increased Section activities.

Section Growth Awards. Annual awards of engraved gavels and certificates were presented to the Toronto, Ont., Canada, and Los Angeles, Calif., Sections in the larger-than-average group and to the San Diego, Calif., and Jacksonville, Fla., Sections in the smaller-than-average group. These awards are based on a combination of increased Section membership and attendance at meetings.

Group-Dynamics. Both the Section Dele-

Table I. Section, Subsection, and Technical Group Statistics

	For Fiscal Year Ending April 30*													
	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
Organizational Units														
Sections	73	73	75	71	81	85	87	89	94	97	100	107	109	**110**
Subsections	6	13	27	35	41	49	51	54	54	51	57	64	62	**65**
Technical Groups	31	54	86	119	111	114	103	100	102	123	115	125	118	**147**
Meetings														
Section	586	617	675	723	757	845	886	924	966	960	1,028	1,079	1,071	**1,090**
Subsection	37	89	150	190	251	329	359	376	331	344	407	421	385	**469**
Technical Group	115	176	359	460	455	440	438	427	443	463	488	540	619	**727**
Joint								3	22	26	27	16	24	**29**
TOTAL MEETINGS	738	882	1,184	1,373	1,463	1,614	1,683	1.730	1,762	1,793	1,950	2,056	2,099	**2,315**
Attendance														
Section meetings	55,307	64,621	77,521	115,171	77,386	85,955	88,799	87,380	85,125	92,464	92,522	91,341	83,604	**81,097**
Subsection meetings	1,853	5,074	8,418	12,111	14,437	18,807	20,252	16,680	13,735	13,825	16,703	15,692	13,546	**17,682**
Technical Group meetings	25,079	26,683	30,706	27,891	30,782	27,471	32,919	22,028	27,195	27,093	24,539	25,764	27,692	**29,217**
Joint meetings								406	2,746	2,199	2,027	1,283	1,573	**2,265**
TOTAL ATTENDANCE	82,239	96,378	116,645	155,173	122,605	132,233	141,970	126,494	128,801	135,581	135,791	134,080	126,415	**130,261**

** For statistics for 1939-43 see 1954-55 and 1955-56 reports*

gates Conference and the Section Representatives meeting included practical demonstrations of the use of group-dynamics techniques, with the assistance of management consultant representatives. An all-day meeting of the executive committee of five Sections and one Subsection in the Rochester, N. Y., area was devoted to the study and practice of group-dynamics in discussions of Section problems. This meeting was also assisted by a representative from management consultants whose services are still available for similar study meetings in other areas. Many Sections are beginning to use group-dynamics in their meetings with success and increased member interest and participation.

Technical Groups. Substantial and encouraging progress is reported in the revitalizing of Technical and Discussion Groups as a major Section activity. Cooperating with the Administration Department, technical interest survey cards were furnished to the Sections for mailing to the entire membership. Results of this survey are not yet complete but it can be reported that many Sections have reappraised their Technical Group organization as a result of the study and many other Sections are initiating or studying a Technical Group program. To implement the Technical Groups further, the Board of Directors has added a representative of the Technical Operations Department to the District Executive Committees, and President M. S. Coover has appointed an ad hoc committee, including the Chairman of the Sections Committee, to study the entire program and to recommend channels for co-ordinating the Technical Groups in the Sections with the corresponding national technical committees.

Assignment of Section Territory. A simplified revision of Bylaw 45 was proposed by the Sections Committee, in effect making assignment of territory to the Sections an administrative responsibility of the Sections Committee and the District Vice-Presidents.

Definition of Section Meetings. The Sections Committee has prepared a statement of policy as to what constitutes a Section meeting to be counted in calculating the Section financial allotment and the Section Growth Award. Pending final endorsement by the Board of Directors, this policy has been adopted as an administrative detail.

Section Finances. A searching study of Section finances and allotments has been initiated by the Sections Committee under an assignment from the Administration Department and the Board of Directors.

District Executive Committees. The Sections Committee has referred to the Administration Department a suggested revision to Bylaw 37 setting up a uniform procedure for appointment of representatives of national Committees and Departments on the District Executive Committees. These representatives would be appointed by the respective Department or Committee chairman with the concurrence of the District Vice-President.

Section Operations Manual. Due to the many administrative and organizational changes in AIEE, a complete revision of the Section Operations Manual was prepared and will be printed for distribution at the 1957 Summer General Meeting.

Section Activities Booklet. Further revision of this booklet, now out of print, is necessary before reprinting for distribution at the 1957 Summer General Meeting.

Model Section Bylaws. The Sections Committee has prepared a completely revised Model Section Bylaws to replace the obsolete Bylaws which have been out of print for some time. The new Bylaws will be distributed at the 1957 Summer General Meeting.

Recognition Certificate for Section Officers and Committee Chairmen. The Sections Committee has prepared a suitable certificate form which can be made available in quantity to the Sections for recognition of services of Section officers and committee chairmen who do not receive certificates from Headquarters. At the present time, certificates are provided only for the Section and Subsection chairmen.

Pamphlet on Technical Groups. A subcommittee of the Sections Committee is preparing a revised pamphlet on Technical Groups to replace a similar pamphlet now somewhat out of date.

Public Relations. Recognizing the importance of public relations in Section activities, the Public Relations Committee was assigned program time at the Section Delegates Conference and the Section Representatives meeting for a clinic or workshop on Section public relations activities. Both sessions were informative and inspirational.

Minimum Standards for Subsections (or Divisions). The Sections Committee has proposed minimum standards for Subsection membership and activity, and has established an administrative procedure for surveying Subsections to determine eligibility for allotment of funds from Headquarters.

The Sections Committee is carrying over from the annual report of one year ago the two important and continuing projects of fostering the use of group-dynamics in meetings of the Sections, Subsections, and Technical Groups, and the further development of Technical and Discussion groups as the most important activity of the Sections. A new project to be carried into the next fiscal year is the study of Section finances and evaluation of the present formula for allotment of funds for Section activities.

Any progress and success in the work of the Sections Committee can be attributed to the untiring efforts of the Committee members and the unfailing co-operation of the national officers, other national committees, and the staff at Headquarters. The fullest possible appreciation of this splendid co-operation is hereby expressed in this annual report of the Sections Committee.

Admission and Advancement Department

The first year the Institute operated under Departments was the 1956-57 fiscal year. The Admission and Advancement Department is one of five, and the Committees making up this Department are Membership, Transfers, and Board of Examiners.

The Department consists of the following: Chairman, Vice-Chairman, Secretary, Chairman of Board of Examiners, Chairman of Membership Committee, Chairman of Transfers Committee, Four Members-at-Large, and liaison representation from Public Relations, Sections, and Student Branches Committees.

During the year, the Department met three times. Organizational details received the maximum attention, but worthwhile objectives continued to come to light as the year progressed. Projects which will receive priority attention during 1957-58 are as follows:

(1) The 100% enrollment of electrical engineering faculties in the Institute. If we are to be successful in interesting electrical engineering students in AIEE, it is imperative that their instructors lead the way as AIEE members.

(2) Rearrange the Student membership year so that contact can be maintained after graduation. Membership interest would thereby be stimulated through (1) Headquarters forwarding issues of *Electrical Engineering* and (2) the Section Membership Committee in the new engineer's first work area.

(3) A practical formula for accreditation of prominent foreign engineering schools. The influx of foreign engineers and their employment in this country has led to the receipt of applications from many of them and, at present, there is no provision for allowing educational credits in the majority of instances.

(4) Continue effort to insure that all Sections maintain active local Transfers Committees. Active local Transfers Committees are essential if we are to insure that all AIEE members obtain the grade of membership for which they are qualified.

Detailed reports prepared by the Membership Committee, the Transfers Committee, and the Board of Examiners follow.

BOARD OF EXAMINERS

The Board of Examiners held regular meetings every month during the past year except August, and acted upon 4,629 applications for admission to or transfer among the grades of membership. This figure is over 9% greater than the number acted upon in the previous year—4,233. The direct admissions were up about 13%, whereas the transfers were down about 4%. The number of direct admissions to Member grade was up again for the second year, 244 as against 160 last year—an increase of 52%. The number of Members recommended for Fellow grade increased from 46 to 55, or about 20%. This increase, together with better prepared proposals, indicates that the membership is becoming acquainted with the requirements for Fellow grade.

In addition to the 11 regular meetings held during the year, a special meeting was held on September 5, 1956, to take care of some administrative work that had to be done and to get it out of the way before beginning on the consideration of applications in the new administrative year.

At this meeting, final approval was given to a new and enlarged Code of Practice on which work had started during the previous year. The Code of Practice was enlarged to give a full description of the mode of operation of the Board of Examiners, to include descriptions of the new educational credits approved by the Board of Directors during the past year, and to reword some sections that were out of date. New members on the Board found the revised Code of Practice very helpful in the orientation it provided and the assistance it gave in handling the regular work.

At the same meeting, the proposed new application and proposal blanks prepared by a subcommittee were presented for study and approval. Final revision and approval was given so that the subcommittee could place them in shape for action by the Admission and Advancement Department. They were placed before this Department in page-proof form at its Winter meeting, and were approved. They are now in the process of being printed. It is planned to inaugurate the use immediately of the Proposal blanks for Fellow grade by asking Sections to destroy the older forms for that grade. The new forms for applications for other grades will be distributed as soon as printed, but applications on the older forms will continue to be accepted.

The backlog of applications that accumulated over the month of August when no meeting was held was particularly heavy, and this resulted in extra long Committee meetings in the Fall, even requiring postponement action on some applications. The President was asked in January to appoint additional members, and after this was done the work at each subsequent meeting was materially expedited.

The Board is giving consideration to the subject of how to secure accreditation of prominent foreign engineering schools. The influx of foreign engineers and their employment in this country has led to the receipt of applications from many of them and, at present, there is no provision for allowing educational credit for them.

Table II. Applications and Proposals Received by the Board of Examiners May 1956 to April 1957

Admission		
Affiliate		
Recommended	337	
Not Recommended	1	338
Associate Member		
Recommended	2,967	
Re-elected	115	
Not Recommended	101	3,183
Member		
Recommended	244	
Re-elected	18	
Not Recommended	22	284
Total Admission Cases		3,805
Transfers		
Fellow		
Recommended	55	
Not Recommended	0	55
Member		
Recommended	712	
Not Recommended	23	735
Associate Member		
Recommended	29	
Not Recommended	5	34
Total Transfer Cases		824
Total Applications		4,629
Student Associate Enrollment		4,760
Student Affiliate Enrollment		361
Grand Total		9,750

MEMBERSHIP COMMITTEE

The milestone of over 50,000 members in the Institute was reached with the April 30, 1957, figure being 50,558. This is an increase of 609 members over a year ago, or a gain of 1.2%.

Table III shows the distribution and the net changes in the membership classifications. The number of new members who qualified was higher than last year, but was more than offset by an increase in the number dropped from the roll for nonpayment of dues. The number of resignations was less than a year ago.

The number of members in arrears for dues as of April 30, 1957, is 2,557, or 5.1%, a reduction of approximately 1%. These conditions are, no doubt, a part of the continuing reaction from the increase in dues in 1955 and points up the necessity of maintaining our present members.

Table IV shows that 3,813 applications were received during the year consisting of 1,503 Student applications and 2,310 "All Others." This shows an increase in the "All Others" and a reduction in "Student Applications Received." This decrease requires an explanation.

In May 1955, Student dues bills were mailed to all Students for their dues for the year May 1955 through April 1956. Those who were to graduate in June 1955 were also mailed an invitation to submit their application for Associate Member, election to be effective May 1 of the following year.

Effective with the June 1956 graduates, a new procedure was adopted whereby these Students could be elected to Associate Member grade almost immediately on receipt of their application. In order to "get the ball rolling" on this new procedure the Student bills and invitations to the June 1956 graduates were mailed earlier, or in March 1956. A good deal of these applications were received before April 30.

Consequently, during the fiscal year May 1955 through April 1956 two groups of applications were received, those from the June 1955 graduates and some of the June 1956 graduates. For the year May 1956 through April 1957 the same procedure of earlier mailing in the previous March was continued and, of course, quite a few applications were received before the end of April. However, during this year there was no comparable group of the previous June graduates applications received. Future years' figures should be comparable as long as these applications continue to be mailed some time in March.

Table V indicates that the total student membership is 9,747, or an increase over last year. The number of new applicants was slightly down, the number of Student Affiliates increased, and the number of student renewals was greater.

Coincident with the introduction of the new membership application form, new procedures in the handling of such forms are also being introduced. The local Membership Committee now has the obligation and opportunity of implementing and reviewing each application prior to its being sent to Headquarters for processing. This

Table III. Membership Statistics for Fiscal Year Ending April 30, 1957

	Honorary Members	Fellows	Members	6 Year Associate Members	Associate Members	Affiliates	Subtotals	Totals
Membership April 30, 1956	7	1,519	11,888	17,485	17,877	1,173		49,949
ADDITIONS:								
New Members qualified	—	—	224	—	2,764	350	3,338	
Former members reinstated or re-elected	—	1	75	126	165	5	372	
Subtotals	—	1	299	126	2,929	355	3,710	
Transfers	—	58	700	3,618	36	—	4,412	
Totals	—	59	999	3,744	2,965	335	8,122	
DEDUCTIONS:								
Died	—	36	92	85	22	2	237	
Resigned	—	2	116	355	226	15	714	
Dropped	—	4	167	1,003	887	89	2,150	
Subtotals	—	42	375	1,443	1,135	106	3,101	
Transfers	—	—	58	595	3,723	36	4,412	
Totals	—	42	433	2,038	4,858	142	7,513	
NET CHANGES	—	17	566	1,706	–1,893	213	609	
Membership April 30, 1957	7	1,536	12,454	19,191	15,984	1,386		50,558

Table IV. Number of Applications Received from Student Members and from All Others

Year Ending April 30	Students	All Others	Total
1943	783	1,431	2,214
1944	466	1,908	2,374
1945	249	2,179	2,428
1946	308	2,453	2,761
1947	938	2,331	3,269
1948	1,481	2,272	3,753
1949	2,286	2,192	4,478
1950	4,033	2,417	6,450
1951	4,168	2,082	6,250
1952	2,591	2,430	5,021
1953	1,614	2,405	4,019
1954	1,157	2,547	3,704
1955	1,045	2,544	3,589
1956	1,699	2,213	3,912
1957	1,503	2,310	3,813

Table V. Number of Students

	Student Members		Student Affiliates		
Year Ending April 30	New Applicants	Renewals	New Applicants	Renewals	Total
1943	2,512	3,200			5,712
1944	2,242	2,656			4,898
1945	2,326	2,287			4,613
1946	2,574	2.513			5,087
1947	5,092	3,929			9,021
1948	7,876	6,041			13,917
1949	9,967	9,461			19,428
1950	7,876	12,792			20,668
1951	4,635	10,393			15,028
1952	3,023	5,834			8,857
1953	2,744	4,038			6,782
1954	3,571	3,333			6,904
1955	3,832	3,834			7,666
1956	4,888	4,188	382		9,458*
1957	4,798	4,324	369	256	9.747*

* Not including men who paid student dues but who were elected to Associate Member or Affiliate membership before April 30.

For 1956 Student Associates		613
For 1957 Student Associates	983	
For 1957 Student Affiliates	28	1,011

Table VI. Record of AIEE Membership Totals as of May 1

1884	71	1910	6,681	1935	14,269
1885	209	1911	7,117	1936	14,600
1886	250	1912	7,459	1937	14,600
1887	314	1913	7,654	1938	16,078
1889	333	1914	7,876	1939	16,605
1890	427	1915	8,054	1940	17,213
1891	541	1916	8,202	1941	17,886
1892	615	1917	8,710	1942	18,944
1893	673	1918	9,282	1943	20,161
1894	800	1919	10,353	1944	21,407
1895	944	1920	11,345	1945	23,072
1896	1,035	1921	13,215	1946	25,090
1897	1,073	1922	14,263	1947	26,470
1898	1,098	1923	15,298	1948	28,408
1899	1,133	1924	16,455	1949	30,791
1900	1,183	1925	17,319	1950	34,198
1901	1,260	1926	18,158	1951	38,058
1902	1,549	1927	18,344	1952	42,220
1903	2,229	1928	18,265	1953	45,426
1904	3,027	1929	18,133	1954	47,923
1905	3,460	1930	18,003	1955	48,993
1906	3,870	1931	18,334	1956	49,949
1907	4,521	1932	18,003	1957	50,558
1908	5,674	1933	17,010		
1909	6,400	1934	15,230		

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places much more responsibility on the local Membership Committee.

Considerable work was done with the Public Relations Committee to provide new information booklets for the use of the Sections, including new booklets: "Why You Should Join the AIEE" and "A Practical Guide for Membership Committees." Considerable use was also made of the "AIEE Today" report and the membership information folder of 1956.

Committees were appointed to co-operate with the public relations committees and the Student Branches Committee. Committees were appointed to evaluate and recommend incentive plans and to check on the matter of delinquent members.

TRANSFERS COMMITTEE

The principal activity of the Transfers Committee during 1956-1957 has been the preparation of a second edition of the "Guide to Transfers of Membership." Of 2,158 copies printed, only about 800 now are left. This new edition was necessary both to incorporate changes and to make several desirable improvements.

Members of the Committee have contacted each Section, promoting transfers activities and offering assistance where needed. Nearly all Sections now have local transfers committees to insure that AIEE members obtain the grade of membership for which they are qualified. Reports of transfers activities during the past year have been received from 43 Sections, or about 40% of the Sections. The following gives a summary of these reports: (1) number of members on the committees, 222; (2) number of Members sponsored for Fellow grade, 43; (3) number of Members advanced to Fellow grade, 28; (4) number of Associate Members encouraged to transfer to Member grade, 2,816; and (5) number of applications forwarded to Headquarters, 215.

Professional Development and Recognition Department

The Professional Development and Recognition Department brings together in a single group those Committees which deal with the development of an engineer as a professional man, from the time he first comes in contact with the AIEE as a student. In this area, the Department is concerned with the award of fellowships to students, with education and accreditation of engineering curricula, ethics and professional conduct, registration as an engineer, and development of management abilities and opportunities. The Committees operating in these several fields carry out their individual programs, but it is the primary function of the Department to integrate these activities into a cohesive program for the development of the engineer. A major part of the work of the Department has been toward the development of a smooth organization which will facilitate co-operative action among the several Committees involved.

The Department is also concerned with the recognition of accomplishment, including the determination of criteria for the award of the Fellow grade, prize awards for outstanding papers, establishment and award of medals by AIEE, and co-operation with other societies in joint awards, and in the development of special projects financed by the Members-for-Life Fund.

Development of the proper attitudes toward professional conduct, unionization of engineers, and further technical and professional development of the individual are complex problems, and the Department seems to be an excellent mechanism for integrating the various functions toward the ultimate goal.

During the year, the Department has held three meetings. Several matters referred to the Department by the Board of Directors have been processed, or are being handled through Committees in the Department.

A new policy for handling the dues of hardship cases was formulated and approved by the Directors. Suggested changes in the requirements for election to the grade of Fellow submitted to the Directors are under review, for recommendation. The Education Committee has set up a permanent screening panel to co-operate with ECPD and to nominate candidates for inspection teams for accreditation.

An important activity of the Department has been the attempts to implement a program previously approved by the Board of Directors to establish additional medals for the recognition of outstanding contributions in the electrical engineering field. Negotiations have been undertaken with several sponsors, and have been completed for the establishment of the Morris E. Leeds Award in Electrical Measurement, to be established by the Leeds and Northrup Foundation. To select the recipient of this award and also the AIEE Medal in Electrical Engineering Education, a new Committee has been authorized within the Department, the Recognition Awards Committee, which should be implemented with the beginning of the new administrative year. In accordance with procedures worked out in the Department, the selection of the recipient for the Medal in Electrical Engineering Education is being transferred from the Members-for-Life Fund Committee, which is providing the funds for the medal, to the Recognition Awards Committee.

In numerous other ways, the Department organization is demonstrating its effectiveness in co-ordinating the activities of related Committees. This has been demonstrated in the work of the Professional Conduct Committee and the Registration of Engineers Committee in connection with proposals for registration laws, definitions of engineering, and policies with regard to registration. The co-ordination function has also been helpful in correlating the work of the Education Committee and the Student Branches Committee, which have many areas of mutual interest. This co-ordination has also extended into relations with the Institute of Radio Engineers under the immediate jurisdiction of the IRE-AIEE Co-ordinating Committee.

The Department has also been active in intersociety awards, participating in the establishment of the new Kettering Award established jointly with SAE, ASME, ASCE, AIChE and AIME. The first award was presented to Mr. Kettering.

EDUCATION COMMITTEE

The Education Committee held two meetings during the year, one at the Fall General Meeting in Chicago, Ill., and one at the Winter General Meeting in New York. The Committee sponsored three sessions and cosponsored two sessions.

At the Summer and Pacific General Meeting, the Committee sponsored a session on "Problems of Getting Young Engineers from College into Industry." The session had two panel discussions. The first was from the point of view of the electronic industry and the second from that of the power industry.

At the Fall General Meeting, the Committee sponsored a session on the "Science of Materials in Electrical Engineering Practice." The first two papers described the need for a knowledge about materials in electrical engineering and the second two papers suggested topics that should be treated in an electrical engineering course on the science of materials.

At the Winter General Meeting, the Committee sponsored a session on engineering education. The speakers at this session described some of the newer courses in electrical engineering with the philosophy behind them.

The Committee also cosponsored two sessions at the meeting in New York. In cooperation with the Computing Devices Committee a session on "University Curricula in Applications of Digital Computers" was held. The session provided information on what the universities are doing to keep their curricula abreast of the advancements made in this new and rapidly expanding field. The session was intended to present to the membership the problems encountered in attempting to teach subject matter that requires elaborate equipment and in obtaining teachers in a field that is characterized by an extreme shortage of people with the necessary background.

The Committee also cosponsored a session with the Student Branches Committee and Research Committee. This session presented some of the problems encountered by industry in obtaining and training young engineers, and the results of a survey made by the Stanford Research Institute on "What Electrical Engineering Seniors Think about Jobs."

The Education Committee believes that one of its main functions is to keep industry informed on what is happening in education. Every generation of engineers in industry judge the present generation of college students and their education in light of what happened to them when they were in college. Engineering education changes, too, as science and technology develop. Therefore, major changes in the electrical engineering curricula must be interpreted to engineers in industry. We will always have to defend the firm core of engineering, science, and the humanities against those who would teach more practical courses. Inasmuch as we believe the former are more enduring we will have to continue to carry this interpretation to industry.

MANAGEMENT COMMITTEE

For the 1956-57 fiscal year, the Management Committee is pleased to report a series of co-ordinated programs and constructive activities. At the General Meetings, related papers were presented on specific themes.

As in the previous year, the Management Committee collaborated with the ASME Management Group in conducting a joint meeting in Pittsburgh. The theme was "Engineering Management Controls." The efforts of the local ASME and AIEE Sections were well co-ordinated with the Institute group playing an effective and important part. The experience obtained in these sessions will enable the AIEE Management Group to conduct next year's joint meeting with the ASME on the basis of equal responsibility and accountability.

For the District Meetings, the Management Committee played a helpful role in suggesting subjects, speakers, and local procedures.

A survey involving the management activities of the Local Sections was both revealing and encouraging. Many Sections are carrying on management activities as part of their regular yearly program. The reports show that the management type of meeting has a broad appeal to the local members. In many cases, this type of meeting met with as much or more acceptance than technical presentations. A list of topics and speakers that have appeared on Section Management programs in the past year has been brought to the attention of all Sections of the Institute.

The experiences of the past year show that in the management field there is a wholesome and expanding vitality in the various levels of the Institute. With sustained direction on the part of the Committee, this function will continue to grow as a major activity in the affairs of electrical engineers.

MEMBERS-FOR-LIFE FUND COMMITTEE

During the current fiscal year, the Members-for-Life Fund Committee has held two meetings—the first in Chicago, Ill., in the Fall of 1956 and the second at the Winter General Meeting in New York, N. Y., early in 1957.

It was voted to award the first of the Medal in Electrical Engineering Education to Dean F. L. Terman of Stanford University, and the presentation was made at a special session held during the AIEE Fall General Meeting in Chicago. In view of the new departmental organization of the Institute, the selection of the annual recipient of the AIEE Medal in Electrical Engineering Education will, in the future, be handled by the Prize Awards Committee although the cost of the Medal will continue to be borne by the Members-for-Life Fund.

The Committee voted to continue its long-established practice of defraying traveling expenses of Student Branch prize paper winners to the Summer General Meeting of AIEE.

Also put into effect by this group is a plan recommended by the Student Branches Committee whereby prizes of $25 and $15 respectively, together with accompanying certificates, will be awarded to the second and third student prize paper winners in each of the AIEE Districts.

As of December 31, 1956, the assets of the Members-for-Life Fund comprised $22,950.60 of which $3,276.38 was in cash and $19,675.22 in investments.

PRIZE AWARDS COMMITTEE

The Board of Directors approved the creation of five new medals for outstanding achievement in the fields of: (1) Communications, (2) Industry and Transportation, (3) Electric Power, (4) Electronics, and (5) Electricity and Magnetism. Work has gone forward in attempting to find sponsors for financing these medals.

Negotiations are in final stages for establishing a new award under the auspices of the AIEE to be known as the Morris E. Leeds Award in Electrical Measurements. The Leeds and Northrup Foundation will finance the award which is planned to be made annually.

Other approaches have been made in searching for sponsors of the projected new medals but these are only in the preliminary stages of exploring possibilities. The Prize Awards Committee (PAC) feels, however, that some of these negotiations will bear fruit eventually.

At the request of the Members-for-Life Fund Committee, the Prize Awards Committee has assumed administration of awarding the AIEE Medal in Electrical Engineering Education. This will be done through a Subcommittee of the PAC supplemented by liaison members from the Members-for-Life Fund Committee and the Education Committee. Requests for nominations for the second award have been issued to the engineering colleges.

The Board of Directors have approved a resolution of the Sections Committee to broaden the scope of recognition of service to the Institute; this to be done by: (1) a certificate for Subsection chairmen or equivalent Division chairmen similar to those now provided for Section chairmen, these to be sent out by Headquarters as now being done for Section chairmen and (2) a form with appropriate blanks be made available to Sections for recognizing service within the Section.

Division and Student Prizes for the 1955-56 administrative year were presented at the 1957 Winter General Meeting. Prizes were awarded papers sponsored by the Communications, Power, and Science and Electronics Divisions.

Plans have been laid to publicize and remind Committees and members of the Institute of the availability of prizes for transactions, papers, and articles in *Electrical Engineering* that have made contributions to the advancement of electrical engineering. PAC has been aware of the need of continuing action enlisting the aid of all sections of the Institute to insure recognizing outstanding literature prepared by its individual members.

PROFESSIONAL CONDUCT COMMITTEE

The Committee sponsored Conferences on Ethics at the Summer General Meeting in San Francisco, Calif., in June 1956, at the Fall General Meeting in Chicago, Ill., in October 1956, and at the Winter General Meeting in New York, N. Y., in January 1957. Two meetings of the committee were held; and, in addition, several members of the committee participated in the meeting of the ECPD Committee on Ethics in Detroit, Mich., in October 1956.

The major project which was undertaken during the past year has been the consideration of a proposed brochure on Rules of Professional Conduct being prepared by the NSPE, largely in response to suggestions arising from the AIEE Committee and previous Institute Conferences. These rules were discussed at the Chicago and New York Institute meetings, and at the ECPD meeting in Detroit; and they were reviewed in detail by this group. It is a pleasure to report that this brochure will be published by the NSPE, and made generally available to the engineering profession some time during the Summer of 1957. The brochure will contain a foreword by Dean C. J. Freund, chairman of the ECPD Committee on Ethics, and will also include the present ECPD Canons of Ethics and supplementary information. It is intended that it be widely distributed to the Institute Sections, as well as to newly registered engineers.

At the January Conference on Ethics, an informal talk was given by P. S. Heath, D.D., General Presbyter of the Presbytry of N.Y., which is scheduled for publication in an early issue of *Electrical Engineering*. This follows up a similar talk given a year ago by L. L. Fuller, representing the legal profession. It is planned to have a similar speech by a representative of the teaching profession at one of the Conferences to be held next year.

At the October meeting of the ECPD in Detroit, an informal understanding was reached for cooperation by the various technical societies, under ECPD guidance, to carry forward additional projects in the field of ethics. One of the most important of these is the preparation of a case book, that can be used in the college teaching of ethics. It is hoped that this project may come to fruition at the forthcoming meeting of the ECPD in October 1957.

STUDENT BRANCHES COMMITTEE

Student membership in the Institute continued to increase to 9,747 as of May 1, 1957. This is an increase of 3.1% over May 1, 1956, and an increase of 27.1% over May 1, 1955. This illustrates the success resulting from repeated forceful application of the policy that all electrical engineering students, as well as all practicing electrical engineers, should join AIEE first.

The Student Branches Committee, at its January meeting in New York, N. Y., reaffirmed its policy that students should continually be reminded that AIEE is the only electrical engineering organization that participates in the development of the engineer professionally as well as technically.

During the fiscal year, the Board of Directors has approved the establishment of two Affiliate Branches.

Two meetings of the Committee were held: San Francisco, in June 1956 and New York in January 1957. Numerous Subcommittees of the Committee met at various places throughout the year, and informal discussions among members of the Committee were held at the 1956 Fall General Meeting of the Institute in Chicago in October 1956.

The Chairman or other officers of the Student Branches Committee have visited most of the District Student Activities Meetings during the past year. These meetings also have proved to be most valuable in providing personnel at the local operating level with an opportunity to present their problems and questions to the level of the Institute at which these problems and questions must ultimately be solved and answered.

The AIEE–IRE Co-ordinating Committee of which the AIEE representatives are W. B. Morton and C. T. Pearce held several meetings during the year to discuss mutual problems.

The Student Branches Committee, through the various Student Branches, again assisted in the promotion of the Eta Kappa Nu "Survey of Employment Opportunities for Electrical Engineering Graduates."

Finances. The complete analysis of costs of Student Branch operation which was made last year became an excellent basis for the preparation this year of a budget for Student Branch operations expenses. For the period May 1956 through April 1957 a total direct expenditure of $49,890 has been budgeted. This does not include the incremental costs of the Institute publications which are applicable to Student Branch operations.

Publications. Throughout the year, the policy of devoting a section of *Electrical Engineering* to Student affairs under the title "Electrical Engineering Education" has been followed regularly. This section of *Electrical Engineering* in every case has been devoted to items exclusively aimed at attracting student interest.

In October, this section of the magazine was quite large with numerous special articles. It was subsequently reprinted with sufficient reprints distributed to all Student Branches for all electrical engineering undergraduates.

Constitution and Bylaws. The revisions of the portions of the Constitution and Bylaws which are pertinent to Student Branches that went into effect this year have appreciably clarified many of the seemingly contradictory statements and ambiguous implications that previously existed. No major revisions are anticipated in the foreseeable future.

Prize Paper Competitions. During the past year, an intensive effort has been made, through direct mail pieces to Student Branch Counselors and other interested per-

Table VII. Student Branches Statistics

	For Fiscal Year Ending April 30						
	1951	1952	1953	1954	1955	1956	1957
Branches	133	132	133	135	135	149	152
Meetings held	1,303	1,178	1,250	1,116	1,158	1,357	1,349
TOTAL ATTENDANCE	63,369	49,324	45,895	49,213	53,325	79,291	90,471

sonnel, to increase student interest in preparation of papers for branch prize competitions.

In February 1957, a poster was sent to each Student Branch for posting on the bulletin board. This poster was specifically devoted to photographs of last year's District Prize Paper Contest winners and each photograph was accompanied by a statement from the prize winner evaluating the value of the contest.

The District Prize Paper prizes were supplemented this year by grants from the Members-for-Life Fund so that District Prize Paper winners now can compete for first, second, and third place cash prizes instead of only a first place cash prize.

In addition to these new cash prizes, more industries plan to follow the practice established in several Districts last year. This inducement consists of providing expense paid trips to the first three prize winners and their counselors to industrial points of interest.

Sections Co-ordination. A Subcommittee devoted to a study of this problem has proposed a means of solving the very difficult problem of keeping track of student members after they graduate. This has always been a problem because of the extreme difficulty of maintaining correct addresses for the graduating students. It is believed that the proposals submitted by this Subcommittee will eventually lead to a solution to this problem.

Student Branch Manual. The 3rd Edition of the Student Branch Manual was distributed in September 1956. It is believed that the revisions made in preparing this edition have resulted in a book which is now in a relatively stable condition.

It is anticipated that the next revision will be aimed primarily at improving the "Suggestions for Branch Operation" portion of the book.

Publicity Promotion. The Subcommittee on Publicity Promotion has assisted in the preparation of the posters for posting on departmental bulletin boards to advertise the Student Branch program.

A new promotional folder was distributed last Fall to all electrical engineering students by the various Student Branches. The Committee presently is developing programs to implement additional suggestions for improving Student Branch publicity promotion.

Meeting Reports. A Subcommittee on the subject of Meeting Reports made an extensive analysis of the manner in which these reports are used by Vice-Presidents and District Chairmen of Student Activities Committees to stimulate increased activity at the Student Branch level. As a result of the activities of this Subcommittee, it is believed that Vice-Presidents, District Student Activities Committee Chairmen, and other interested personnel are now more effectively using the meeting report as a means of detecting and correcting lack of Student Branch activity.

This Committee also has developed a means of permitting applicants for student membership to indicate their wishes regarding subscriptions to the Bimonthly and *Transactions* publications of the Institute.

Sound Slide Film Program. The expanding library of sound-slide film programs was increased during the past year by two new additions. "Kilowatt Insurance" presents an engineering story of the electric distribution transformer. "Atomic Energy Challenges the Electrical Engineer" presents some of the current activities of electrical engineers engaged in atomic energy.

The mechanics of distributing these programs through the Chairmen of the District Student Activities Committees were improved during the past year.

Program for District Prize Paper Contest Winners. A complete new approach to the problem of properly recognizing and entertaining District Prize Paper winners at the Summer General Meeting was instituted this year. This program consisted of the establishment of a planned sequence of activities for the prize paper winners from the time they arrived at the Summer General Meeting until they leave. It also provided complete and thorough advance instructions to the prize paper winners regarding such matters as travel expenses, hotel accommodations, and so forth.

Panel Discussion at 1956 Fall General Meeting. The Student Branches Committee collaborated with the Management Committee in the preparation of a panel discussion on "Young Electrical Engineers in Industry." This panel was composed of young electrical engineers no more than five years out of college. Their discussion related to an evaluation of the ways in which their college education had contributed to their development as practicing engineers. They also discussed the changes that might be made in the curricula which they pursued to improve the abilities of future graduates to progress as practicing engineers.

Education Session, 1957 Winter General Meeting. The Student Branches Committee participated in a session at the 1957 Winter General Meeting sponsored by the Education Committee. The papers at this session dealt with various aspects of electrical engineering curricula at four different leading universities.

Participation in Student Affairs. The Student Branches Committee welcomes comments and suggestions by any member or Student Member of the Institute. Many worth-while suggestions have been made by individuals in the past year. It is important that all members understand the importance of the need for maintaining a high level of interest by electrical engineering students in the AIEE. They are the future leaders of our profession.

Publications Department

The Publication Committee has been reorganized into the Publications Department with four Committees as follows: (1) Periodicals and Transactions, (2) Educational Publications, (3) Special Publications, and (4) Surveys.

The Periodicals and Transactions Committee will carry out the broad general policies of all periodical publications including *Electrical Engineering*, the Bimonthlies, and the *Transactions*. The Educational Publications Committee will have general supervision of all educational publications including the section on "Electrical Engineering Education." The Special Publications Committee will deal with the problems of special publications, technical conference publications, preprints, and reprints. The Surveys Committee will have the responsibility of special tasks and the collection of data to maintain a high standard of publication.

Electrical Engineering. This publication is planned to be of greatest interest for the majority of members. A new section, "Electrical Engineering Education," has been established to provide a better channel of communications for students and faculty members.

A readership survey sent to 1,000 different members each month in proportion to the number of members in each state has yielded valuable data. Members rate the different departments in the magazine as well as their first choice of feature articles and cumulative choices. For the second time, readers have rated the "Review of Engineering Developments" in the January issues, as first choice relative to the feature articles in those issues; therefore, the space devoted to this subject matter has been increased by 10 pages. Figure 1 shows a comparison of readers' first choice of six broad departments in the magazine with the distribution of 1,200 editorial pages devoted to each of the departments expressed in per cent. A comparison of subject matter in *Electrical Engineering* for the past three years with the primary interest of members as expressed in the 1951 survey and the more recent survey last Spring is shown in Table VIII. When it is considered that the newly created Instrumentation Division was a part of the Basic Sciences Division in 1951, it is of interest to note how closely the two surveys compare. The 1951 survey represented a 51% return of the membership at that time, and the 1956 survey an unusually good return of 61½% of the membership. Interesting results from the monthly survey are that members prefer more general articles, 62%, to technical articles, 38%, and one-page digests, 81%, to briefer digests, 19%. All results from the monthly survey, with the exception of the "Engineering Developments" in the January issue, are represented by six months' cumulative data.

Advertising. Through the opening of a Midwest advertising office with an additional salesman and the addition of a market research consultant to the staff, this activity has been further increased. Another rate increase has been taken in stride without loss of pages. The increase in the number of pages in the first quarter of 1957 compared with the first quarter of the previous year was 20.9%. This compares with an increase of 6.1% for an industrial group of approximately 200 business publications and an average increase of 10% for the 14 leading electrical publications during the same period. The total number of paid advertising pages for the year ending April 30, 1957, was 1,223, or a 28.6% increase by volume, compared with 951 pages for the previous year. The gross billings were $156,476 in excess of the gross billings for the previous year. Notwithstanding rising costs, the publishing position of the Institute has been greatly improved. For the forthcoming year, it has been estimated that the net cost of all publications will be still further reduced to $56,500 from an all-time high of $187,000 in 1955 as shown in Figure 2.

Bimonthly Publications. The availability of these publications have been made better known to the membership through announcement with the annual dues statement in May 1956. This announcement increased the average annual circulation of each of these publications by 3,000 copies. The total number of pages produced was 3,032. The excess of 136 pages over the previous year, combined with the increases in size of the editions and a 14.3% printing price increase effective January 1, 1957, makes these publications expensive. A proposal to divide the subject matter more finely and to include news of the industry and Conference papers was considered by the Publications Department; but it was concluded that the Bimonthlies were satisfactorily meeting the needs of the membership and, as they were strictly a source of high quality technical material, they should not be used as a means of communicating news, excerpts from the minutes of Technical Committees, and other material.

Transactions. Volume 75 of the 1956 *Transactions* will be issued in three parts—Part I. Communication and Electronics; Part II. Applications and Industry; and Part III. Power Apparatus and Systems. All three parts contain a total of 446 papers in 3,028 pages, which is a 9.5% increase in the number of pages issued in Volume 74 of the previous year. The annual bound volumes serve a useful purpose by preserving a record of advancement of the art in libraries.

Special Publications. There were 10 special publications issued during the year with a total of 1,724 pages; six of these contained the papers and discussions from as many technical conferences and four others were special projects of the technical committees.

Year Book. Work on the new directory of the AIEE is in progress and copies should be available by the time of the Summer General Meeting. Many changes in addresses as a result of the survey last Spring retarded the production work and made necessary the discarding of standing type. The new directory will be distributed to all officers and committees without charge, and the publication will be sold to other members at $2 per copy. The first listing will be alphabetical with the names and addresses of all members and the next listing will be geographical consisting of names only.

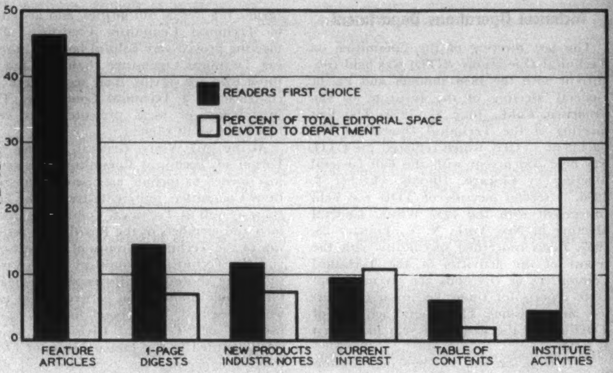


Fig. 1

Table VIII. Comparison of Subject Matter in *Electrical Engineering* with Primary Interests of Members

	Primary Interests of Members		Subject Matter in *Electrical Engineering*		
Divisions	1951 Survey	1956 Survey	1954	1956	1957
Science and Electronics	17.1%	13.1%	26.9%	39.5%	23.4%
Instrumentation		5.1			2.3
Communication	13.5	10.4	19.3	14.7	15.8
Power	45.0	41.8	26.9	21.1	36.0
Industry	17.0	22.2	14.8	12.8	13.3
General Applications	7.4	7.4	12.1	11.9	9.2
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%

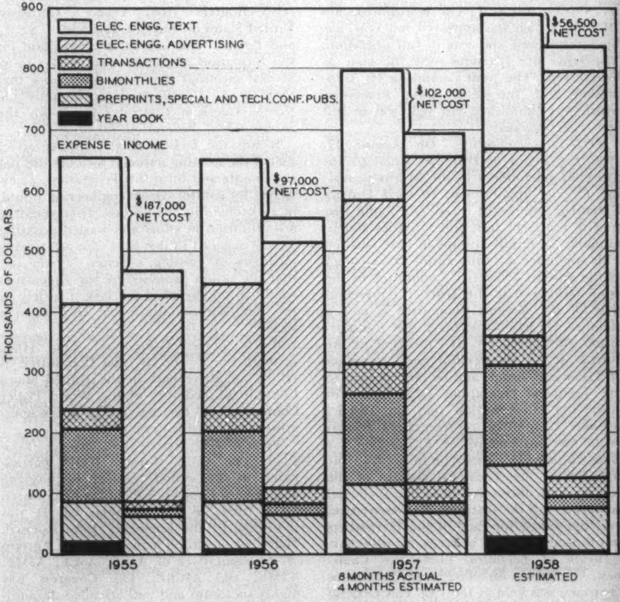


Fig. 2

Technical Operations Department

The last meeting of the Committee on Technical Operations (CTO) was held concurrent with the 1956 Summer and Pacific General Meeting of the Institute in San Francisco, Calif., June 27, 1956. The first meeting of the Technical Operations Department (TOD), which replaced the CTO, was held concurrent with the Fall General Meeting in Chicago, Illinois, October 3, 1956. A second meeting of TOD was held concurrent with the 1957 Winter General Meeting in New York, N. Y., January 23, 1957. Items concerned specifically with the report of the activities of the Technical Committees or Divisions are given in separate reports for those Technical Committees and Divisions. The general activities of TOD during the past fiscal year have been as follows:

TOD Organization. The new organization of the AIEE, as reported in the September 1956 issue of *Electrical Engineering,* has five Departments. One of these Departments is the Technical Operations Department. This reorganization was brought about because it was felt that the present size of the AIEE necessitated redistribution of the workload in order to relieve the Board of Directors. Much of the responsibility, which in the past rested with the Board of Directors, is now assigned to the individual Departments. The co-ordination of the activities which overlap from one Department to another will be the responsibility of the Planning and Coordination Committee. It is felt that this new organization will result in a closer knit and a faster acting system than AIEE has had in the past. There has been no change in the status or increase in the number of Divisions or Technical Committees during this year. The Instrumentation Division, which was approved last year, has been formalized and was in full operation. The other five Divisions were the same as for last year. The Joint Committee on Automation and Integrated Data Processing which was established last year was in full operation this year.

TOD Representatives. On August 17, 1956, the Board of Directors voted to approve an amendment to the Bylaws providing for the appointment to each District Executive Committee a resident of the District to represent technical activities and to promote Technical Groups in that District. This appointee is a fully authorized member of the District Executive Committee in the same fashion that the District representatives of the Sections Committee is now a member. He has voting privileges, transportation allowances, etc. His function in the District is the sponsorship and promotion of Technical Groups and he reports back to the Technical Operations Department, in much the same fashion that the District Sections Committee representative reports to the Sections Committee. This action was taken to provide a closer tie-in between the activities of the Technical Groups of the Sections with the activities of the Technical Committees of the Institute. Representatives were appointed for each of the 11 Districts and they are working towards this objective.

Forum of Technical Committee Chairmen. A Forum for Technical Committee Chairmen was held at the 1956 Fall General Meeting. The purpose of this Forum was to review the duties, authorities, and activities of Technical Committee Chairmen. The meeting proved very helpful both to incoming Technical Committee chairmen and to those who are serving their second term as chairman of a Technical Committee. The interchange of ideas presented was very beneficial to all present.

At the 1957 Winter General Meeting, the Forum of Technical Committee Chairmen was opened to include members of the Sections Committee, representatives of the Sections as well as Technical Committee chairmen and members of the Board. The activities of the Technical Groups of the Sections and the Technical Committees of the Institute were thoroughly discussed and means for a closer co-operation between these two were presented. A proposal for the establishment of "Technical Divisions," which was presented in the January issue of *Electrical Engineering* was presented and discussed. As a result of the interesting discussion which this meeting instigated, a committee was established by President Coover to study the proposal and determine what type of organization should be established to suit AIEE needs best in the technical activity field.

International Federation of Automatic Control Systems Engineering. The AIEE, upon invitation, has joined an International Federation of Automatic Control Systems Engineering. This Federation is world-wide and has as members of the North American chapter the AIEE, ASME, IRE, ISA, and AIChE. The purpose of the Federation is to co-ordinate the activities in the field of control system engineering on a world-wide basis. In September 1956, an organizational meeting was held in Heidelberg, W. Germany, which was attended by representatives from France, Germany, United States of America, England, U.S.S.R., and Poland. The foundations were laid for the formation of the International Group. Several meetings have been held since that time in the United States to organize the North American Control Council for the International Federation.

It was the feeling of all representatives that if the existing national societies did not collaborate and form this Federation, a new society for control system engineering would, in all probability, be formed. This would be a duplication of effort and wasted activities of men engaged in this field who are already members of existing societies. It was felt that the action proposed by the Federation would fulfill the need for such a society in this field without the actual creation of a society.

World Power Conference. The AIEE, through the Power Division Committee, is taking an active part in the United States Committee's activities of the World Power Conference and has contributed to the operating fund for this Committee.

Nuclear Engineering and Science Congress. The AIEE, through TOD, participated in the second Nuclear Engineering and Science Congress which was held March 11-15, 1957, in Philadelphia, Pa. It was sponsored by the Engineers' Joint Council, under the operating management of a group of representatives of AIEE, ASCE, AIME, ASME, and AIChE. The Congress was highly successful and well attended. In addition, the Fifth Atomic Energy and Industry Conference, the Fifth Hot Laboratories and Equipment Conference, and the Third International Atomic Exposition were all held during this particular week in March, and in the same city. The exhibit accompanying the meeting was quite large and attracted considerable interest.

Technical Operations Department Manual. A Committee has been created to formulate a Manual for TOD which would include the definition of the duties, authorities, and responsibilities of Subcommittee, Committee, Division, and TOD officers of their respective organization. Much of this information is already available but has not been brought together into one Manual.

General Interest Survey. During the past year, the AIEE membership was solicited for information necessary for the Year Book. At the same time, additional information was obtained relative to the business, industry and occupation, and function of AIEE members as well as their Technical Committee interests. The information thus obtained has been tabulated and was presented as part of the TOD Forum at the 1957 Winter General Meeting. Pamphlets giving the result of this tabulation can be obtained from AIEE Headquarters.

Classification for Electrical Engineers. A Committee has been working for TOD to determine a classification for electrical engineers. This work is not quite completed.

Communications Division

COMMUNICATION SWITCHING SYSTEMS COMMITTEE

During the 1956-57 year the Committee sponsored three technical sessions, two at the 1956 Summer and Pacific General Meeting and one at the 1957 Winter General Meeting. A session is scheduled for the 1957 Summer General Meeting, and plans are under way for sessions in the forthcoming Fall and Winter General Meetings. Papers have been presented covering a wide variety of subjects. These include design and manufacture of switching relays, telephone switching traffic considerations, switching theory, and new electronic switching techniques.

At the present time, a number of new techniques are entering the communication switching field. The Committee has the objective of keeping its membership informed of these new developments. Remote line concentrators have been discussed in one paper, and a second paper on this subject is scheduled. Preliminary plans have been made for a future session devoted to a new semielectronic concentrator development. The Committee is also keeping in touch with major new developments in electronic telephone switching systems and will present information on these developments as soon as it can be released for publication.

COMMUNICATION THEORY COMMITTEE

Technical sessions were sponsored at the Summer and Pacific, Fall, and Winter General Meetings, as well as Committee meetings at each. Another session is ready for the 1957 Summer General Meeting.

The general approach has been largely to sponsor talks by experts in Information Theory and other branches of Communication Theory, but with the presentation designed for the average engineer who is not expert in these fields. The audience response has been enthusiastic and it seems clear that this fills a real need for many people.

The programs have been varied in nature from historical and tutorial discussions to presentations of theoretical studies still in progress. It is felt that the varied fare has been an important factor in the considerable interest shown.

RADIO COMMUNICATION SYSTEMS COMMITTEE

The Radio Communication Systems Committee is justifiably proud of the many fine technical papers prepared and presented at various meetings of the Institute, as a result of its direct efforts and in co-operation with other Committees during the past year. Also, the Committee members have been most co-operative and responsive in promoting the work in all its phases. However, attendance at the technical sessions sponsored by the Committee leaves much to be desired, despite the fact that the recent survey of the interests of Institute members indicated that the subject of Radio Communications Systems was one of the more popular of the Communication Division activities. Further thought is being given to means for improving attendance at technical sessions.

The proposal to concentrate papers on particular subjects at specific national meetings of the Institute which was referred to in last year's report has received further consideration. It has been found that often sufficient papers on a particular subject cannot be procured to occupy an entire technical session, unless presentation of some papers are held over for one or two meetings to make this possible. It seems undesirable to postpone papers, however, as this would have an adverse effect on authors who feel generally that the interval between filing a paper and its publication already is too long.

During the past year, the Committee has adopted the plan of designating one of its members to act in a co-ordinating capacity for each of the meetings of the Institute where the Committee foresees the need for a technical session. An effort is made to pick, for this purpose, a member living in or near the city where the meeting is to be held. He is requested to follow up on the papers planned for the meeting, to co-ordinate with the local committee on arrangements for the meeting and to stimulate attendance at the session through special publicity or direct contacts with interested people or agencies in the area. Frequently, the member serving in this capacity is an ideal choice for chairman of one of the technical sessions at the meeting for which he has assumed responsibility.

TELEGRAPH SYSTEMS COMMITTEE

The Committee sponsored one technical session each at the Summer and Pacific, Fall, and Winter General Meetings. Full Committee meetings, as well as meetings of the Printing Telegraph Subcommittee, were held at the Fall and Winter Meetings.

A number of new developments in facsimile printing were covered by individual papers presented at the General Meetings. In addition, many important developments in facsimile printing during the year, which were not of sufficient magnitude to warrant individual papers, were collected and presented in a single paper. The favorable response to this presentation probably will result in an annual paper of this nature.

Interest in the telegraphic transmission and terminal handling of business data for use in integrated data processing systems continued to increase. One paper described a nation-wide telegraph system designed for integrated data processing, and other papers dealt with transmission and error checking of data.

The Printing Telegraph Subcommittee continued its work on proposed standards for test circuits and methods to be used in testing telegraph apparatus, tolerances of receiving mechanisms to distortion in received signals, and maximum permissible distortion in transmitted signals.

TELEVISION AND AURAL BROADCASTING SYSTEMS COMMITTEE

Two technical sessions have been sponsored by the Committee at each of the Summer and Pacific, Fall, and Winter General Meetings. Advances in the television and radio art have been described by many papers of general interest, together with a lesser number of detailed papers of interest, mainly to specialists in this field. The papers presented have covered such subjects as television frequency allocations; television satellite, booster, and translator stations; color television transmitting equipment, receivers, and recording on embossed monochrome film; closed-circuit television; transistor radio receivers; scatter propagation; microwave television equipment and systems; high fidelity amplifiers; remote control of broadcast transmitters; and aspects of recent research in television and radio.

Meetings of the Committee were held during each General Meeting. The principal activity was program developments for future meetings. The Committee has explored the closed-circuit aspects of television, including educational and industrial uses, and has planned further technical sessions devoted to this subject. The Committee is active in the work of the Standards Committee, and it is participating with other committees in problems of maintenance of electric equipment. The Committee has continued to recommend qualified engineers for advancement to Fellow grade in AIEE.

Several members of the Committee are participating in the work of the Television Allocations Study Organization (TASO), which was established upon recommendations of the FCC. TASO represents many broadcasting and manufacturing interests, and it is seeking to obtain full technical information about present and potential UHF and VHF television service. This engineering information is to be submitted to the FCC for its use in determining the soundest approach to the problem of television channel allocations. The executive director of TASO is a member of the Committee.

A relatively small number of AIEE members are directly concerned with television and radio broadcasting, and the Committee is endeavoring to expand such membership. This would also increase the attendance at the technical sessions sponsored by the Committee, which sometimes has been disappointing. Various methods to improve attendance are being studied and tried.

WIRE COMMUNICATION SYSTEMS COMMITTEE

The Committee sponsored two sessions at the Summer and Pacific Meeting, and, in collaboration with other groups, three sessions each at the Fall and Winter General Meetings. The application of carrier to rural subscriber lines continues to be of major interest, but papers generally ranged over the entire field of telephone wire communications including local and toll networks, their transmission properties, and the supporting subscribers' instruments, together with such ancillary subjects as protection from lightning and power line interference and burying practices for underground cables. At Chicago, Ill., two sessions encompassing the interests of the entire Communications Division treated broadly the subject of maintenance of wire line systems and, in some degree, covered associated microwave systems. A quite lively interest in maintenance attitudes and procedures was exhibited at these sessions.

At the Winter General Meeting, one session was devoted to subscribers' loud speaking telephone instruments, or "hands free telephony." One session in the wire communications area but which, because of its historic character was presided over by the President of the Institute, was very impressive. It was devoted to the recently completed transatlantic telephone cable and included brief presentations and responses exchanged over the cable by members of AIEE, the Engineering Institute of Canada, and the Institution of Electrical Engineers who respectively were also engineers and officials of participating American communications companies, the Canadian companies, and the British Post Office, all meeting simultaneously in New York, N.Y., Montreal, Que., Canada, and London, England. The presentation was heard by a large audience. A series of papers covering this new communications advance is scheduled for simultaneous publication in organs of the Institute, the Institution of Electrical Engineers, and in the Bell System *Technical Journal*.

For the 1957 Summer General Meeting scheduled for Montreal, two sessions are planned, with emphasis upon telephone and telegraph communications in Canada and on advances in European communications.

General Applications Division

AIR TRANSPORTATION COMMITTEE

The technical subcommittees of the Air Transportation Committee have been active during the past year in developing and pursuing the assignments given them. As a result, several guide reports, test codes, and standards have reached either the point of being submitted to the Standards Committee or are in the review stage by the Air Transportation Committee. Consequently, the technical responsibilities of the Committee seem to be well in hand.

The annual meeting of the Committee was held in conjunction with the District meeting May 7-9 in Dayton, Ohio. At that time, in addition to the annual business meeting of the Committee, a number of technical sessions were sponsored during which between 50 and 55 technical papers were presented. The activities of some of the subcommittees were reported on in considerable detail to the membership through the presentation of papers prepared by subcommittee members during this annual meeting.

Considerable effort has been expended to assure proper co-ordination of the activities of the Air Transportation Committee with other technical groups working in the general area of aircraft electrical problems. Particular emphasis has been placed on liaison with the AIA and the A-2 committee of the SAE.

It is expected that the Committee will tentatively schedule the location of the annual Committee meeting for the years of 1961 and 1962 during the coming Annual Meeting. It has been found that the practice of scheduling meetings several years in advance eases the specific problem of organizing a session on relatively short notice.

DOMESTIC AND COMMERCIAL APPLICATIONS COMMITTEE

The principal work of the Committee continues to be carried on by its Subcommittees. All of the Subcommittees co-operated in sponsoring a single technical session at the 1957 Winter General Meeting and an annual meeting of the Committee was held on the same day.

The Committee continues to maintain liaison with the AIEE Standards Committee, two ASA Sectional Committees, and the Inter-Industry Farm Electric Utilization Council.

The two Subcommittees on Electric Space Heating and Heat Pumps (East and West) report continued interest in the electrical aspects of these subjects from electric utilities, equipment manufacturers, and users. An increasing number of companies are going into the production of packaged heat pumps and increased sales effort is expected to develop. This applies to both the residential and the larger commercial and industrial applications. The air-to-air units, because of their relative simplicity, appear to be the most popular.

Electric resistance space heating for homes is increasing at a rapid rate, even in the more northern parts of the country. A number of studies are being made on the electrical characteristics and performance of this type of load and the Committee proposes to present suitable technical papers on the subject to the Institute from time to time.

The Farm Electrification Subcommittee held a highly successful Special Technical Conference in Memphis, Tenn., in the Fall of 1956. The interest shown for various electrical engineering applications on the farm has been so great that the Subcommittee plans to hold another Conference in the Fall of 1957, probably in St. Louis, Mo.

The Domestic Appliances Subcommittee has been most active during the past year. Its Eighth Appliance Technical Conference was held in Detroit, Mich., on May 20 and 21, 1956. The major theme of the conference was "Appliance Developments and Controls." This Subcommittee is proceeding with plans to enlarge its technical conferences by co-operating and working with other technical societies. A joint Conference is proposed for 1958 and contacts are being made with such diverse groups as the American Institute of Chemical Engineers, American Society of Heating and Air-Conditioning Engineers, American Society of Refrigeration Engineers, American Society for Metals, Institute of Radio Engineers, and Gas Appliance Manufacturers Association.

LAND TRANSPORTATION COMMITTEE

Progress is being made in many phases of land transportation activity. This progress has been reflected in the volume and diversity of papers presented at Land Transportation Committee technical sessions during the current administrative year. Among the subjects treated in these papers were rectifier locomotives, lightweight trains, gas-turbine-electric locomotives, and commercial-frequency railroad electrification. Several of the papers on rectifier locomotives were presented in a joint session with the Industrial Power Rectifiers Committee.

The growing requirements of large metropolitan areas for transportation service present an important challenge to the land transportation industry. The role of railroad electrification in meeting this challenge was the subject of the Committee's four-paper symposium on "Electrification of Railway Commuter Service" at the 1956 Summer and Pacific General Meeting.

Standardization projects undertaken by two Subcommittees has advanced during the current year. AIEE Standard No. 11 on "Rotating Electric Machinery on Railway Locomotives and Rail Cars and Trolley Gasoline-Electric and Oil-Electric Coaches" has been submitted to ASA for approval. The Standardization of Locomotive Wiring Diagrams Subcommittee is arranging for AIEE sponsorship of AAR Standard Wiring Diagrams for ASA adoption.

The Insulation Resistance Testing Subcommittee has reviewed the need for testing of locomotive rotating electric equipment, and recommends thorough study of test requirements in each of three functional categories—Terminal Tests, Overhaul Test, and Motor Repair Shop Tests. An important consideration in each of these tests is that of adequacy of the winding for future service, and the Subcommittee recommends that studies be made in this area.

The Diesel-Electric Traction Subcommittee is progressing toward presentation of information on the "Dollar Damage Done by Dirt." This is a subject which merits careful consideration by electrical engineers of dieselized railroads, because of the influence of dirt upon motive-power maintenance expense and reliability.

Other Subcommittees are actively planning for presentation of timely papers on rapid transit equipment, electrified cars for commuter service, diesel-electric locomotive application, and other topics during the 1957-58 administrative year.

MARINE TRANSPORTATION COMMITTEE

The principal responsibility of the AIEE Marine Transportation Committee is the recommending of good engineering practices with respect to the application and installation of shipboard electric equipment of all types. These recommendations are contained in AIEE publication No. 45 "Recommended Practice for Electric Installations on Shipboard" and are maintained up to date through regular revision every three years. The issue now in use is dated March 1955.

The Committee, in accordance with its established practice, held two meetings during Institute year, one in October 1956 and the other in May 1957. Among the more significant additions and revisions adopted for inclusion in the next issue of AIEE No. 45 were: (1) marine galley equipment, (2) use of fuses for back-up protection, and (3) mineral-insulated cable.

The Committee continues to act as the advisory group to the United States National Committee of the IEC on the matter of international standardization of marine electric installations. This work is being carried out through Technical Committee 18 of the International Electrotechnical Commission. A representative group, consisting of six members of the AIEE Marine Committee, represented the United States at an international meeting of some 13 countries held in Rapallo, Italy, on May 13-18, 1957. This conference is a continuing effort to enlarge the area of international agreement pertaining to ocean-going vessels. Previous meetings at Philadelphia, Pa., in September 1954 and at The Hague in December 1955 resulted in agreement and approval for the issuing of a first edition of IEC recommendations "Electrical Installations on Ships."

The Committee will sponsor a marine session at the AIEE Winter General Meeting in New York, N.Y., early in 1958. This action is a continuation of the Committee's policy of arranging for and conducting a biannual marine session as a part of the Winter General Meeting in New York.

The Marine Transportation Committee is a diversified group and consists of 23 members. These members have been drawn from various segments of industry and Government agencies vitally interested in marine electrical rules and practices. Eight members are from manufacturers of marine equipment, six are from shipbuilding companies, three are from ship operators, three are from Government agencies, two are from regulatory bodies, and one is from a naval architect organization. Although the membership on this Committee has been maintained over a period of years at about its present level, there has been a steady influx of new members. This is considered desirable both from the standpoint of participation by a wide segment of interested groups and also from the standpoint of injecting fresh and progressive thinking. Of the present membership, 40% of the Committee is new when compared with the Institute 1953-54 fiscal year. Although this percentage change is quite appreciable, it is considered that it does not preclude the maintenance of continuity of service of experienced personnel so necessary to the formulation and promulgation of well-founded recommendations.

PRODUCTION AND APPLICATION OF LIGHT COMMITTEE

The Committee sponsored a technical session at the Winter General Meeting on the subject of high-frequency lighting. Four papers covered all phases of this topic from power sources and distribution to applications and economics. The attendance at the session, and the discussion following the presentation of the papers, showed this subject to be of considerable interest to Institute members.

A Committee meeting was held during the Winter General Meeting attended by 14 including a former chairman. The Committee is endeavoring to obtain closer liaison with other committees because lighting is an allied subject and belief is that joint sponsorship with other groups would be the best method of fulfilling its obligation to Institute members. The scope of the Committee is to be studied and redefined. As published, it seems to be contradictory to Institute practice with respect to the reportorial aspect of the Committee.

Subcommittees were organized for the Midwest and West Coast in order to provide a better means of formulating programs at the Fall General and Pacific General Meetings. The West Coast Subcommittee met at San Francisco during the Summer and Pacific General Meeting and discussed the need of papers on lighting and lighting power supply systems in electrical engineering and the possibilities of interesting consulting electrical engineers in modern lighting techniques and practices.

Industry Division

CHEMICAL INDUSTRY COMMITTEE

The present slate of officers for the Chemical Industry Committee assumed its duties at midyear 1956. However, the first major meeting for which these officers planned sessions was the 1957 Winter General Meeting in New York, N. Y. The first Committee meeting with the current officers was held at the Fall General Meeting in Chicago, Ill. October, 1956.

At the 1957 Winter General Meeting in New York City, one session was sponsored on Chemical Processes, one on Cathodic Protection, and two on Electrochemical Processes. Of the last two sessions, one included a Symposium on "Safety Protections for Electrochemical Plants."

Plans are now under way to sponsor technical sessions at the 1957 Fall General Meeting in Chicago, one session at the Pacific General Meeting in August 1957, in Pasco, and at the 1958 Winter General Meeting. Papers are also being obtained for contribution to the various District meetings.

A Committee meeting was held during the 1957 Winter General Meeting, with the Vice-Chairman presiding. Plans for future technical sessions were discussed. The Electrothermal Process Subcommittee reported that six meetings were held in collaboration with NEMA and FEMA on Standards for Furnace Transformers, and that considerable progress had been made.

ELECTRIC HEATING COMMITTEE

The Electric Heating Committee has been active through its three Subcommittees in the electric heating field.

The Induction and Dielectric Heating Subcommittee has collected technical data on radio interference and the problems involved for submission to the Federal Communications Commission, in line with the rewriting of the Recommended Practice for Measurement of Field Intensity above 300 Mc from Radio-Frequency Industrial, Scientific, and Medical Equipments.

The Data Subcommittee has been collecting general tables and information on electric heating for the Institute to publish.

The Radiant Heating Subcommittee has been involved in work on high-power radiant heating sources.

A two-day conference on Electric Heating was held in Toledo, Ohio, in April and was attended by some 280 persons. The fields of induction, dielectric, furnace, direct resistance, radiation, and other types of electric heating were covered.

ELECTRIC WELDING COMMITTEE

During the week of April 8-12, 1957, the Electric Welding Committee joined with the American Welding Society for the Technical Session Program of the Adams National Meeting. The Committee sponsored three technical sessions: one on arc welding and two on resistance welding, comprising a total of nine papers. The total registration for the technical sessions was 1,839. Average attendance at each of the three sessions sponsored by the Committee was approximately 75. The AIEE Philadelphia Section, under the chairmanship of S. M. Kapell, joined with the local AWS Chapter to arrange all local activities.

The Subcommittee on Resistance Welding Instrumentation completed Report No. 1 covering the nature and magnitudes of the variables to be measured. This report was submitted to the Special Instruments and Auxiliary Apparatus Committee in January 1957 for instrumentation recommendations. To date, no reply has been received from this Committee.

The Fundamental Arc Research Subcommittee has been inactive, and a revision of membership is being considered.

Future projects of the Electric Welding Committee involve development of application data for series and shunt capacitors for resistance welding machines, and an examination of the suitability of the present light flicker curve for voltage changes with durations of less than one cycle of power line frequency.

FEEDBACK CONTROL SYSTEMS COMMITTEE

The Feedback Control Systems Committee sponsored technical sessions at both the Fall General Meeting and the Winter General Meeting. The Fall General Meeting attendance was disappointingly low. However, the Winter General Meeting was well attended by an interested and enthusiastic audience. In addition to this activity, the Components Specifications Subcommittee, under the chairmanship of Harold Chestnut, has been active in the establishment of standards for feedback control systems components.

The Committee has been considering with favor participation in an international federation of automatic control interests. The purpose of this federation would be to provide an attempt at covering the sponsorship of international conventions, exchange of information, and standardization in the field of control engineering and automatics. Participation by other engineering societies has also been solicited and, probably, will take effect.

After a lapse of three years with no Technical Conference, the Committee decided to sponsor a Conference on the subject of "Computers and Control Systems," organized by a committee headed by Dr. Truxal. Plans for this Conference are well advanced, and foreign participation is being solicited. The dates for this conference are October 16-18, 1957, and it is to be held at Atlantic City, N. J. The expected attendance is some 300 or more members and nonmembers. It is planned to hold Conferences of this type more regularly than in the past, with a goal toward its being an annual event.

Technical sessions have been planned for the Summer General Meeting, including a session in which a number of prominent speakers will discuss the future trend in control systems.

GENERAL INDUSTRY APPLICATION COMMITTEE

This Committee operates six Subcommittees covering the application of electric equipment in various industries. These have been in operation for several years and as a whole are now well established. The Committee is now considering the possibilities of establishing new Subcommittees to serve industries that now do not have any satisfactory meeting ground such as that provided by the Special Technical Conferences of our Subcommittees. Some of the industries under consideration are: Electric Testing Equipment, Food Processing, Flour Milling, Furniture Manufacturing, Cement, and Tobacco Industries.

The activities of the Subcommittees during the past year were as follows:

Paper and Pulp. This Subcommittee held its annual Conference at Gainesville, Fla., on March 8 and 9, 1956, with an attendance of 92. There were 10 conference type papers presented, all of which were well received. The 1957 Conference was scheduled for March 28 and 29, 1957, at Georgia Institute of Technology at Atlanta, Ga. Their plans now are to present one Conference per year, rotating the location from University of Florida at Gainesville to Georgia Tech at Atlanta and then possibly to the University of Maine.

Textile. This Subcommittee held one Conference at Georgia Tech, on March 1 and 2, 1956, with an attendance of 150. On November 1 and 2, 1956, it sponsored another Conference at North Carolina State College, Raleigh, N. C., with an attendance of 200. Its Spring Conference in 1957 was held at Georgia Tech, on March 7 and 8. The program consisted of six conference type papers and one panel type discussion. This Subcommittee is also sponsoring one session at the 1957 Summer General Meeting in Montreal on June 25.

Materials Handling. This Subcommittee did not hold any Conferences during the 1956-57 AIEE fiscal year. Its next Conference is scheduled in the Spring of 1958.

Machine Tool. This Subcommittee held its annual Conference at Cincinnati, Ohio, on October 22-24, 1956. There were 12 conference type papers presented of which the majority dealt with application of numerical controls to machine tools. One-half day was allowed for visitations to the leading manufacturing plants in the Cincinnati area. The total registration was 692. The 1957 Conference is scheduled to be held in Milwaukee, Wis., the 1958 in Hartford, Conn., and the 1959 will be in Cleveland, Ohio.

Pacific Coast. This Subcommittee sponsored one session at the 1956 Summer and Pacific General Meeting in San Francisco during June. It is now preparing for one session at the Pacific General Meeting in Pasco, Wash., on August 28-30, 1957.

Rubber and Plastics. The annual Conference of this Subcommittee was held in Akron, Ohio, on April 8-9, 1956, with an attendance of 330. There were eight conference type papers presented as well as a report of its special committee on electric equipment in contaminated atmospheres. It has appointed a special committee to investigate the standardization of electrical practices for this industry. Its 1957 Conference was scheduled for April 8-9, 1957, at Akron, Ohio.

INDUSTRIAL CONTROL COMMITTEE

Meetings of the Industrial Control Committee were held concurrently with the Fall General Meeting in Chicago and the Winter General Meeting in New York. A technical session was sponsored at the Fall General Meeting and two technical sessions at the Winter General Meeting. An additional session at the Winter General Meeting was cosponsored with the Computing Devices Committee. The Committee will sponsor one five-paper technical session at the Summer General Meeting in Montreal. Nearly all of these papers are by Canadian authors.

Test Codes Subcommittee. The Test Code prepared by this Subcommittee has been approved by the Committee, has been submitted to the AIEE Standards Committee, and is at present under review.

Electronic Control Subcommittee. Work on revisions of a proposed standard for electronic d-c motor controllers, on which a report was presented as a conference paper at the Winter General Meeting in 1956 is continuing and it is expected that a standard will shortly be ready for submission to the AIEE Standards Committee for their consideration.

Regulators and Feedback Systems Subcommittee. This Subcommittee maintains a liaison with the Feedback Control Systems Committee. Co-operation with the American Standards Association on Y10 and C85 is continuing.

Motor Protection Subcommittee. This Subcommittee was formed during the year to work with the corresponding Subcommittee of the Relay Committee in the Power Division in a general effort to outline application and standard requirements for overload protective devices. The chairman of this Subcommittee is A. H. Myles. At present, the regular organization of the Subcommittee is not complete.

Static Switching Subcommittee. This is a proposed Subcommittee, approval for which has been requested from the Industry Division Committee. There is some controversy regarding the proposed scope of this Subcommittee but it is expected that this will be resolved prior to the Summer General Meeting. Because this subject is new and very active at the present time, it is considered essential that this Subcommittee be organized at the earliest possible time.

INDUSTRIAL POWER RECTIFIERS COMMITTEE

This Committee has been very active over the past administrative year. The well-attended meeting of the Main Committee, held on January 23, 1957, in New York, indicated the interest of the membership in the activities of the Committee.

A technical session, cosponsored by the Land Transportation Committee, was held at the Winter General Meeting in New York.

A two-day Conference on "Rectifiers in Industry" will be held in Chicago June 4-5, 1957, jointly sponsored with the Semiconductor–Metallic Rectifier Committee and the Chicago Section.

A technical session, featuring papers presented by Canadian members, is scheduled for the Summer General Meeting in Montreal.

The West Coast Subcommittee, which sponsored a fine technical session, and held a Committee meeting, at the 1956 Summer and Pacific General Meeting in San Francisco, will sponsor a technical session at the 1957 Pacific General Meeting to be held at Pasco, Wash.

Members of the Industrial Power Rectifiers Committee have worked many hours on Standards, with the following results:

1. The draft of the International Electrotechnical Commission Standards for Mercury-Arc Power Rectifiers, prepared by IEC Committee 22-1, has been accepted by all 60 nations voting. The draft has been sent to the Secretariat for publication. These standards were used as a basis for revision of ASA C34.1.
2. The Working Group for the Revision of the ASA C34.1 for "Pool Cathode Mercury-Arc Power Converters" reported the acceptance, by this Committee, of the revised standards, which have been submitted to ASA for approval.
3. The tentative NEMA Standards for rectifiers used as a power supply for main drive rolling mill motors has been reviewed by the Mercury-Arc Converters Subcommittee. A working group will be appointed to observe the reception of these tentative standards, with the object of making recommendations to the Subcommittee as to the action AIEE should take.
4. The Mechanical Rectifier Subcommittee has prepared a preliminary draft of definitions for mechanical rectifiers.
5. Members of this Committee are among those working on the Draft of IEC Recommendations for Semiconductor Rectifiers which will be discussed and acted upon at the meeting of Technical Committee No. 22's Subcommittee 22-2 in Moscow, Russia, U.S.S.R., July 2 to July 12, 1957. It is of particular importance in the field of power rectifiers to co-ordinate symbols, definitions, terminology, and nomenclature with accepted standards.

The Working Group on Protection of Electronic Power Converters has submitted for approval a tentative chapter "Fault Characteristics of Power Rectifiers" to the Working Group of the Low-Voltage Air Circuit Breaker Subcommittee engaged in preparing a guide for the calculation of faults on d-c circuits.

INDUSTRIAL POWER SYSTEMS COMMITTEE

The Committee, during the administrative year 1956-57, held six independent sessions at the Summer and Pacific, Fall, and Winter General Meetings. There was a general increase in attendance at these sessions indicating a greater interest in power distribution by representatives from industry.

During this past year, two publications of this Committee were made available for sale. The Red Book published as a Committee Report and completed by the Electric Power Distribution for Industrial Plants Subcommittee became available in the Fall of 1956, and by the end of February 1957, some 4,000 copies had been sold. Considerable publicity by the Committee and Headquarters has assisted in announcing this Report. The companion publication, the Green Book entitled "Grounding of Industrial Power Systems" is also a Committee report and was developed by the Industrial Grounding Subcommittee. To date, 2,000 copies of this book have been sold.

The Electrical Systems for Commercial Buildings Subcommittee is beginning to wind up its efforts in preparing the Gray Book. This book will become one of the most valuable guides to engineers in planning electric equipment in all types of commercial buildings.

During the Winter General Meeting, the Industrial Power Systems Committee had one of its largest committee meetings. It was reported by those attending that managements in industry now are more interested in their electric systems which are a very predominant part of their operations.

The Pacific Coast Subcommittee is planning a session at the 1957 Pacific General Meeting. This Subcommittee is maintaining its relationship with the Main Committee by having representatives at the General Meetings.

The Codes and Standards Subcommittee has taken on a new responsibility of developing standard nomenclature and designations for the types of electric distribution systems commonly found in industry. This is anticipated to be a standard for all those associated with the industrial distribution of electric energy.

The Characteristics of Loads Subcommittee has been reinstated as a part of the activities of the Industrial Power Systems Committee. They are now organizing for evaluating and publishing information on the characteristics and requirements of loads and groups of loads that occur in plants and buildings.

MINING AND METAL INDUSTRY COMMITTEE

The Metal Industries Subcommittee has been active in the field of electric power distribution in steel plants and in electric systems for automatically controlling thickness of steel strip on tandem cold reduction mills. Three technical sessions were held at the Summer and Pacific General Meeting in San Francisco.

Papers were developed and presented dealing with distribution practices generally and the problem of fluctuating loads from the viewpoint of both the steel plant as a user and the electric utility as a supplier of electric power. The problems of interconnection where the steel plant generates power and where fluctuating loads are supplied was also considered.

The trend toward automation and the increasing use of automatic control systems in the steel industry were analyzed. Significant contributions to the art were made by technical papers reporting on extensive analyses of the problems of automatic gauge control on tandem cold reduction mills. The analyses presented went beyond anything existing in the literature covering both the steady-state and the transient conditions existing when the thickness of steel strip is being regulated automatically in the five stands of a tandem cold reduction mill.

Attention was given to the application of electric equipment in arc furnace systems in steel mills. At the Winter General Meeting in January 1957, three papers were given covering analytical background, application rules, and suggested practices.

The continuing high level of activity in the coal mining industry is reflected in the increased interest and participation in Eastern Mining Subcommittee activities. Two sessions were sponsored at the 1956 Fall General Meeting in Chicago, one on silicone insulation for mining motors and another on motor maintenance, hoists, shovels, and grounding.

Preparations are being made for two sessions at the 1957 Fall General Meeting. Papers on mine lighting, shuttle cars, efficiency loss effects on heating in motors and cables, voltage variation effects, trolley poles, circuit breaker settings, and similar subjects are being solicited.

Considerable interest is being shown in the use of a-c power in underground coal mines. It is felt that the mining industry will benefit from several sessions dedicated to this subject, and efforts are being made to culminate such plans in the near future.

PETROLEUM INDUSTRY COMMITTEE

Good progress, as evidenced by technical papers sponsored by the Committee, in the use of the new electronic and other tools for more accurate control of processes and/or automatic and remote control, was made by the producing, refining, and transportation divisions of the petroleum industry. Because of the great number of new installations of sequenced and remotely or automatically controlled pipeline pumping stations, the Transportation Subcommittee felt it advisable to work up and recommend a proposed supplement to American Standard C37.2 in an endeavor to obtain standard nomenclature for control and other devices used in pipeline pumping stations.

The Committee sponsored its third annual Special Technical Conference at Kansas City, Mo., and definite plans have been formulated for the 1957 Conference to be held in Philadelphia, Pa., the 1958 Conference in Dallas, Texas, and the one for 1959 in Long Beach, Calif. Two technical sessions were held at the 1957 Winter General Meeting, and a joint Refining–Chemical session is planned for the 1959 Winter General Meeting. The Committee is studying the problem further, but poor attendance at technical sessions presented at all General Meetings thus far indicates that the vast majority of petroleum industry electrical engineers much prefer to concentrate on one three-day annual Special Technical Conference on the petroleum industry only.

Instrumentation Division

ELECTRONIC AND HIGH-FREQUENCY INSTRUMENTS COMMITTEE

The conversion of the Instruments and Measurements Committee to Division status and the subsequent smooth transition of the work on Electronics and High-Frequency Instruments to that of Committee status within this Division was undoubtedly due to the previous, autonomous operation of the subcommittees within the old Committee as reported last year. The Electronic and High-Frequency Instruments Committee opened its first meeting, held in October 1956, with a review of its scope and a note that the instruments themselves were to be given emphasis along with the techniques of using them for making measurements.

The short official history of the Electronic and High-Frequency Instruments Committee necessitates commenting on work in progress rather than on results obtained. One of the projects under discussion by this Committee is a systematic classification of instruments and test equipment as used in electronic research and development laboratories and the ultimate establishment of uniform specifications for them. Work is in progress to establish standards for d-c amplifiers, regulated power supplies, and counters. The Committee also is cosponsoring a technical session on Instrumentation at the NEC in October 1957.

FLIGHT TEST INSTRUMENTATION COMMITTEE

During its first year, this Committee has secured three technical papers and three abstracts for additional papers to be ready for the Pacific General Meeting, Pasco. At that time the first technical session will be sponsored. Present papers report developments in automatic handling of flight test data, telemetering in flight test instrumentation, and miniaturization of flight test instruments.

The following modified title and scope has been proposed for this Committee:

Title: Aircraft and Flight Test Instrumentation Committee

Scope: Treatment of all matters in which the dominant factor is the use of electrical methods in the measurement of quantities pertaining to aircraft, missiles or other bodies in flight including the devices necessary thereto.

NOTE: An important aspect of this field includes telemetering of flight measurements. In matters where the dominant factor is this aspect, these will be referred to the Committee on Telemetering.

The foregoing modifications have been approved up through the Instrumentation Division Subcommittee on Organization.

INDICATING AND INTEGRATING INSTRUMENTS COMMITTEE

With the formation of the Instrumentation Division, and the assignment to a full Committee cognizance of Indicating and Integrating Instruments, the Committee formation was completed in the Fall of 1956. Two working subcommittees were formed to cover the respective subjects of indicating instruments, and integrating instruments including watt-hour meters. A well-attended meeting of the Committee was held during the Winter General Meeting, where outlines of future work assignments for the subcommittees were discussed in great detail.

At the Winter General Meeting, two technical sessions were held at which a variety of papers were presented.

At the Committee meeting, the dearth of papers on new developments in the field of watt-hour meters was stressed and papers on this phase of measurement were solicited. As a result, four papers for the Summer General Meeting in Montreal have been made available on various phases of watt-hour meter design. A total of nine papers are anticipated for two sessions at Montreal.

An important item which has been studied at length at the Bureau of Standards is an analysis of the response of thermoelement converters, which are used not only for the determination of a-c values as such, but also in computers and as transducing elements in a miscellaneous variety of gear. A detailed analysis of the response of these elements has been made and will be presented at the Montreal meeting along with suggestions as to a preferred method for obtaining this parameter so that the method can be used as a standard procedure both for inspection purposes as well as in the engineering application of these items.

Plans have been made to present a report at the Summer General Meeting covering the findings of Dr. F. K. Harris, National Bureau of Standards, who is making an official trip around the world to investigate standardizing practices in other countries. This report should be most interesting and may give us a new base for international comparison of our prime electrical units.

This new Committee thus appears to be functioning satisfactorily. Its organization for the next year is established and it is believed it will continue the growth evidenced in the past in the old Instrument Committee which grew into a full Division.

NUCLEONIC AND RADIATION INSTRUMENTS COMMITTEE

This Committee was established in 1956 in the Instrumentation Division. The nucleus for its operation came from the Group Subcommittee on Nucleonic and Radiation Instruments under the Instruments and Measurements Committee in the Science and Electronics Division and partially from a Nucleonic and Radiation Instruments Subcommittee of the Nucleonics Committee in the Science and Electronics Division. Much has been accomplished during the past year by concentrating in several areas of endeavor.

Scope. This Committee encompassed the broadened field of reactor instrumentation and control bringing in over a score of papers, many of which were of *Transactions* caliber and many of which were recommended for publication in condensed form in *Electrical Engineering.*

Personnel. Partly through the effort of the Committee and partly unsolicited, almost 30 experts in the field have volunteered their services to the Nucleonic and Radiation Instruments Committee.

Sponsoring Sessions. Co-operating with the Nucleonics Committee or alone, sessions were sponsored at the Nuclear Science and Engineering Congress and also at AIEE meetings.

Standards. A Subcommittee of experts has been arranged to work in this field and with ASA if required.

The modified scope formally proposed shortly after formation of this Committee is being adhered to and favorable action by the Division to get it approved is recommended. The scope is as follows:

"Treatment of all matters in which the dominant factor is the use of electrical methods for the instrumentation of nuclear reactors and for the measurement of nuclear quantities and alpha, beta, gamma, and X radiations, including the devices necessary thereto, especially when the application has reached the stage of appreciable commercial requirement and involves novel types of engineering development."

Note: Co-operative action in this field is expected with IRE and ISA and effective AIEE action requires adoption of this broadened scope.

In addition to a chairman, vice-chairman, and secretary, the Committee is operating with a Detector Subcommittee, a Reactor Instrumentation Subcommittee, a Standards Subcommittee, and a Papers Subcommittee, as well as a West Coast Subcommittee.

There is also liaison personnel keeping in close contact with IRE and its professional groups and subcommittees, the American Nuclear Society, the Instrument Society of America, the AIEE Nucleonics Committee, and the Scintillation Counter Symposium.

At the 1957 Nuclear Congress (March 11-15), 20 sponsoring organizations conducted the 2nd Nuclear Engineering and Science Conference. On instrumentation, there was a session on "Reactor Plant In-Instrumentation" led by AIEE members E. E. Lynch and T. S. Gray with 5 AIEE and one IRE paper. Also, a session on Reactor Control and Simulators led by ASME Rufus Oldenberger and AIEE M. A. Schultz with 2 AIEE and 2 ASME papers. Also, a session on Reactor Instrumentation Development led by AIEE members G. A. Morton and H. A. Lamonds with 6 AIEE papers. Thus, a total of 13 AIEE papers on instrumentation were presented. Many were definitely of *Transactions* caliber. These sessions were made possible by the co-operative efforts of this Committee and that of the Nucleonics Committee headed by P. N. Ross.

The 1956 Scintillation Counter Symposium was held February 28-29 at the Shoreham Hotel in Washington, D.C., sponsored by AIEE-IRE-AEC and NBS. Attendance was 400 and was very successful with an enthusiastic audience. Plans are progressing for the 6th Scintillation Counter Symposium in 1958. AIEE's main sponsorship is through the Nucleonics Committee inasmuch as most papers cover the physics and research aspects, but our Committee offers any assistance desired and possible.

The Committee is prepared for any desirable standards action, and to date has centered around preparation to assist ASA.

Recommendations have been made in order that any action necessary be taken by the Instrumentation Division in co-operation with the Science and Electronics Division to insure close liaison with action relating to standardization in the nuclear or atomic reactor instrumentation field and in order to guard against any action detrimental to the proper treatment of matters within the scope of the Committee.

Also, because IRE has standards committees investigating fields of standardization within the scope of this Committee by personnel who are members of both AIEE and IRE, the formation of a joint subcommittee (AIEE-IRE) is highly recommended.

The January 1957 issue of *Electrical Engineering* carried 6 photographs and a half page on nucleonic and radiation instruments in the article on "1956 Engineering Developments." Lee Holthausen carried a full column in the San Francisco Section's *San Francisco Engineer* (Dec. '56) on activity in the nuclear instrumentation field on the West Coast (AIEE).

Conference papers for the Nuclear Congress in March produced suitable material for articles in *Electrical Engineering.*

Other societies are active in the nuclear instrumentation field especially ANS, IRE, and ISA. Close liaison is being kept with the activities of these organizations through liaison representatives of this Committee.

Authors and manufacturers seem to want to send papers to one organization rather than to a number and a strong bid is being made by this Committee to be the leader in the nucleonic and the reactor instrumentation and control field.

The Nucleonic and Radiation Instruments Committee and its various Subcommittees expect to build up organization and painstakingly and completely cover the areas within the scope of the Committee such as:

1. *Papers.* Do not neglect reactor instrumentation or control or the components that make it up. Cover design, development, application and allied areas. Watch for prize award papers.
2. *Initiate Sessions.* Conferences, Symposiums, etc., be initiated either individually or jointly with other AIEE technical committees or other technical societies. IRE, ISA, ANS, AIF, are interested in closely allied areas. Co-operate on scheduled sessions.
3. *Standards.* Initiate and progress new programs and co-operate on existing programs. Manufacturers groups will cover even the technical standards unless they are covered adequately from both their points of view, as well as the Institute's.
4. *Bibliographies.* A valuable contribution is possible and should be made in this area either individually or jointly with other groups.

RECORDING AND CONTROLLING INSTRUMENTS COMMITTEE

The Recording and Controlling Instruments Committee has had a very active year in completing its organization as a member of the Instrumentation Division. An Organization Subcommittee was formed for consideration of an increased scope for the activities of the Committee. This Subcommittee has finished its assignment and a report to the Instrumentation Division will be forthcoming shortly, requesting a scope that will include recording and controlling instruments in their broadest forms and their use in systems.

The need for a broader scope in the Recording and Controlling Instruments Committee has been brought about by the electrical engineer's interest in the new and fast-growing technologies that are appearing in the areas of data handling and data processing, analog and digital computers, dynamic control analysis, and the ever-increasing use of the systems approach to automatic control problems. The Committee recognizes the increased use of new recording means, such as magnetic film, punch cards, punch tape, and magnetic drums. The impact of digital computation and digital recording is being felt more and more by the electrical engineer. The advent of control systems with great sophistication has brought about a realization of the need for the systems approach and its many new techniques for analysis.

The AIEE is just beginning to receive technical papers from its members on such subject matter as indicated in the foregoing paragraph. It will be necessary to expand the membership of the Committee to include engineers who are active in these new technical fields. It is hoped that the membership can be increased to cover these activities before the beginning of the new fiscal year.

The Committee sponsored a technical session at the Winter General Meeting at which five papers were presented. These papers were all in the present conventional fields of recording and controlling instruments. It is hoped that during the coming year papers can be obtained in these new areas.

SPECIAL INSTRUMENTS AND AUXILIARY APPARATUS COMMITTEE

When the Instruments and Measurements Committee became a Division on August 1, 1956, one of its group subcommittees became the Special Instruments and Auxiliary Apparatus Committee. At the same time, the six subcommittees under the group became subcommittees of the new Committee.

The Committee sponsored a session at the Winter General Meeting and will sponsor one session and cosponsor a second session at the Summer General Meeting. Committee activities have been largely organizational in nature this year. In addition to two new subcommittees mentioned later, a third will be required to carry on a program in measurements on resistance-welding equipment.

The Dielectric Measurements Subcommittee has just had the "Code for Dielectric Measurements in the Field" published on a trial basis. The Subcommittee is now organizing a session on dielectric measurements for a conference in the near future. The High-Voltage Measurements Subcommittee is the group that revised AIEE Standard No. 4. The same personnel comprise a Sectional Committee of ASA. This Subcommittee sponsored a session at the 1957 Winter General Meeting and is also preparing a session for January 1958.

The Instrument Accessories Subcommittee is investigating the uniformity of d-c shunts with the idea of a possible code in mind. The Rotary Speed Measurements Subcommittee has been preparing a code for such speed measurements. The most recent draft is being examined for revision by representatives of the Rotating Machinery Committee.

The Geophysical Instruments and Measurements Subcommittee and the Spectroscopy Subcommittee have been in a process of organization. There has been definite interest in these activities in some quarters, and the Subcommittee chairmen are endeavoring to prepare realistic Institute programs.

In addition to these six subcommittees, the Institute year will see two additional subcommittees activated. One of these has to do with determination of ground resistance and potential gradients, the other with standardizing procedures and certification of electric devices. The first of these subcommittees is now preparing a bibliography of material in its field and expects to sponsor a session at the Winter General Meeting. Personnel from the Bureau of Standards have indicated a lively interest in the activity on standardization and may be expected to assure a very active program.

Power Division

INSULATED CONDUCTORS COMMITTEE

The Insulated Conductors Committee continued its high rate of activity during the past year. It is impossible to describe all of the activities of the Committee in this report; however, the following will be of interest.

Progress on Soil Thermal Resistivity Study. This study, conducted at Princeton University, has progressed to the point where emphasis now is being placed on the experimental phases to develop suitable nuclear meters for rapid nondestructive determination of density and moisture content in the field; development of laboratory equipment and methodology for determining the influence of soil granulometry, structure, density and moisture content on thermal resistivity; and development of a general theory of moisture transfer in soil under thermal gradients and the design of laboratory methodology to test the theory and its practical implications.

Insulation Studies. Development of new and better insulations is always of great interest to the Committee. During the year, a Symposium on Polyethylene was held jointly with the Dielectrics Committee. Further activity of the Insulations Subcommittee is directed toward development of insulations for extra-high-voltage cables and improvement of cable oils.

Aerial Cable Protection Studies. Work continues on the lightning protection of aerial cables and a joint session with the Protective Devices Committee has been scheduled for the 1957 Summer General Meeting in Montreal.

Recomputation of Cable Carrying Capacity Tables. A project is under way to recompute cable carrying capacity of cables in ducts. Present tables were developed many years ago and need to be reviewed in the light of present knowledge.

During the year, close contact with European cable engineering activities was maintained by the European Practice Subcommittee. A number of reprints and tranlations of technical papers were secured and made available to the membership of the Committee.

Many other worthwhile activities too numerous to mention are being carried on by the Insulated Conductors Committee.

POWER GENERATION COMMITTEE

Four Committee meetings, usually associated with several Subcommittee meetings, were held during the year. Three of the four meetings took place during General Meetings, at all of which technical sessions on a constructive range of subjects were sponsored.

Committee work has again been directed toward improved longer range planning for future technical activities. Changes have been recommended for the scope of the Committee and the scope of the Excitation Systems Subcommittee. The Committee recommended adoption of a revised scope for the Application of Probability Methods Subcommittee, a joint activity with the System Engineering Committee and Transmission and Distribution Committee.

The method of Committee operation has been altered during the year. The new procedure involves a meeting of the Committee officers and Subcommittee chairmen, followed by Subcommittee meetings and then the full Committee session. Results thus far have been very encouraging.

Liaison representation has been reviewed and increased materially during the year.

Prime Movers Subcommittee. This Subcommittee has continued its work on new developments in prime movers.

Prime Mover Control and Protection Subcommittee. The activities of the Subcommittee have included a review of power plant protection from the control and relay standpoint over the past year and will look into such protection as it is affected by different temperature and pressure ranges coming out of the installation of supercritical boiler, turbine electric generators.

The Subcommittee has also worked jointly with the System Engineering Committee on the application of incremental heat rates involved in loading electric systems on an economic basis. This is being expanded toward a joint session or sessions sometime in the near future at one of the General Meetings.

The Subcommittee is also actively pursuing control and protection involved in the operation of hydroelectric units. Progress should result in reports or papers in the not too distant future.

A very active program of work is outlined, looking to constructive future sessions.

Station Design Subcommittee. During the year this Subcommittee sponsored sessions dealing with re-evaluation of postwar power plants and indoor vs outdoor designs. Other work led to papers covering auxiliary systems for large high-pressure steam turbine–generator sets as well as design and operational features of cross-compound turbine–generator units.

Excitation Systems Subcommittee. An "Industry Hearing" session on excitation system response was sponsored at the 1956 Fall General Meeting. Progress is being made by the working group on excitation system definitions and it is anticipated that the coming year will see this project completed.

Hydroelectric Systems Subcommittee. Steady progress has been made in sessions sponsored in this area of activity.

Application of Probability Methods Subcommittee. This Subcommittee completed and issued a final report on "Forced Outage Rates of High Pressure Steam Turbines and Boilers." Much work has been done on the subject of a simplified and more easily understood explanation of the results attainable from the application of probability methods to power system problems, which it is anticipated will lead to an interesting session in the near future.

Joint AIEE–ASME Recommended Specifications for the Speed Governing of Prime Movers Subcommittee. This Subcommittee completed its "Recommended Specification for Speed-Governing of Steam Turbines Intended To Drive Electric Generators Rated 500 Kw and Larger" during the year. This specification is under review and will be discussed at a forum-type session in the near future, together with governor specifications and internal combustion engine specifications.

POWER SYSTEM COMMUNICATIONS COMMITTEE

During the 1956-57 administrative year, the Technical Operations Department approved the request of the former Carrier Current Committee to change its name and scope. The new name is Power System Communications Committee and the revised scope recognizes the responsibilities of this Committee in all phases of power system communications.

The Committee sponsored technical sessions and held Committee meetings at the 1956 Summer and Pacific General Meeting and the 1957 Winter General Meeting. In addition, a technical session sponsored jointly with the Relay Committee was held at the Winter General Meeting. The microwave phase of this Committee's activities continues to increase, whereas power line carrier, although still an important subject, is decreasing in activity.

Executive Subcommittee. This Subcommittee has the continuing function of assisting the chairman. Its activities during the past year were directed mainly toward the successful completion of the change in Committee name and scope.

Methods of Measurement Subcommittee. Members of this Subcommittee are continuing to obtain data pertaining to the carrier characteristics of transmission lines, cables, and equipment. They have been handicapped by the resignation of their chairman. A new chairman will be selected shortly with the expectation that the work of this Subcommittee will be speeded up considerably.

Microwave Subcommittee. The Microwave Subcommittee continues to encourage technical papers on microwave. They have been outstandingly successful in this effort. Plans for the future include obtaining technical data on the performance of microwave installations.

Carrier Bibliography Subcommittee. This Subcommittee is continuing its activity to keep a complete up-to-date record of the literature on power system communications. A bibliography was published in 1956 and, therefore, the Subcommittee's only activity is accumulating material for the next revision, which will probably be made about 1960.

Standards for Carrier Radiation Subcommittee. This Subcommittee is inactive, with only a chairman designated. It can be reactivated at any time there appears to be a need for further study of radiation from power line carrier.

Equipment Design Standards Subcommittee. This is a new Subcommittee approved by the Power Division. Its personnel has been selected and good progress is being made in formulating standards for power system communications equipment.

PROTECTIVE DEVICES COMMITTEE

Continued work on the revision of standards and studies relating to neutral grounding devices and lightning protection has been the major activity of the Protective Devices Committee and its Fault Limiting Devices Subcommittee and Lightning Protective Devices Subcommittee during fiscal 1956-57. Various papers on these subjects, sponsored by the Protective Devices Committee were presented at the Summer and Pacific, Fall, and Winter General Meetings. In particular, the Winter General Meeting Symposium on Lightning Protection and Lightning Experiences on Transmission Systems was of considerable general interest.

Fault Limiting Devices Subcommittee. Continued progress has been made by the working group revising AIEE Standard No. 32. Considerable thought and study has been given to:

1. A method for calculating short-time temperature limits for neutral grounding devices (excluding resistors) which is now fully developed. A similar procedure for resistors is under study.
2. A revision of the definitions for system grounding. The term "coefficient of grounding" is being considered for use in place of the present terms "ungrounded, effectively grounded, and solidly grounded." These latter terms attempt to define the degree of system grounding in terms of system reactance and resistance parameters. The coefficient of grounding, on the other hand, would define the degree of system grounding in terms of the ratio of phase-to-ground voltage during a fault, to the normal line-to-line voltage at the same point on the system just prior to the fault.

A study has been authorized and a working group is being established to review AIEE Report No. 954 "Application Guides for Ground-Fault Neutralizers, Grounding of Generators and Grounding of Transmission Systems" for the purpose of determining what additions and revisions are needed to bring these Guides up to date. It is contemplated that small working committees to carry on the actual work of revision will be set up as soon as the magnitude of the job becomes known.

A working group also is being established to investigate and make recommendations on problems associated with lowering ground impedance on delta-connected systems including the application of grounding transformers and associated problems such as relaying and load unbalance. Considerable interest is developing in the industry in the problems associated with the application of grounding transformers to convert an ungrounded system to a four-wire distribution system.

Lightning Protective Devices Subcommittee. The working group preparing a "Report on Lightning Arrester Applications for Stations and Substations" presented their monumental work to the AIEE at the 1957 Winter General meeting. This report makes available, for the first time in one publication, data typifying arrester application practices in the United States. As time goes on, some of the values used in this report may require modification, but the basic concepts should remain valid for the foreseeable future.

The strength of insulation when subjected to irregular or otherwise nonstandard impulse voltage waves is of major concern to the working group studying multicircuit substations. It is recognized that such a question is of wide interest and others are invited to offer solutions on odd wave evaluations.

The data on the performance of aerial cable presently being assembled by a working group should be available in 1957. The working group results, taken in conjunction with papers sponsored by the Subcommittee, should do much to clarify the seemingly anomalous aerial cable failures experienced in various parts of the country.

Co-ordination of Insulation Subcommittee. This Subcommittee functions in a liaison capacity between the Protective Devices Committee and AIEE Standards Coordinating Committee No. 8. This latter Committee has held no meetings during the 1956-57 fiscal year, but its members are contemplating a report covering a standard array of BIL for guidance on establishing apparatus BIL and in economic studies of future extra-high-voltage systems.

RELAYS COMMITTEE

The Relays Committee makes use of 12 active Subcommittees. These Subcommittees meet, as required, twice a year on the day before the Spring and Fall meetings of the Committee.

Bibliography of Relay Literature Subcommittee. This Subcommittee submitted Transactions Paper No. 57-72 at the Winter General Meeting, January 1957, which brings the bibliography up-to-date through the years 1953-54.

Relay Standards Subcommittee. This Subcommittee has submitted a conference paper type of interim report on "Revisions to Relay Standards," Paper No. 57-71. During the past year, this Subcommittee has made substantial progress in updating the American Standard for Relays Associated with Electric Power Apparatus C37.1-1950. It has revised or created new definitions for 58 terms and has reached agreement that the present format of this Standard is inadequate for present expanding technology. The Subcommittee has been instrumental in suggesting an agenda for the International Electrotechnical Commission's relay standardization project.

Despite these accomplishments, there is a feeling among the Committee members that the rapid strides being made in the field in relay technology are creating new terminology and nomenclature at a faster rate than old problems are being settled. Plans to offer a revision to the Standard C37.1 during 1957 have been dropped and a dissemination of AIEE Conference Paper No. 57-71 "Interim Report on Revisions to Relay Standards" is now contemplated. By properly publicizing this conference paper it is hoped that the value of releasing a new Standard will be met sufficiently to permit a delay of approximately one more year in issuing a revision of the present 1950 edition of this relaying Standard. This delay will permit preparing a more complete and useful Standard.

Other Subcommittees continue to be active, and as their work is accomplished, additional reports will be issued.

ROTATING MACHINERY COMMITTEE

The Committee is approaching the end of its postwar revision of the Standards it sponsors. During 1956-57, three revisions of old Standards have been recommended to the Standards Committee and the revisions of the remaining two probably will be ready next year. Work was completed on two new Standards this year and most of the Subcommittees are working on new projects described in detail in the paragraphs which follow.

The two new Standards on insulation system evaluation completed by the Committee last year and printed this year provide a means for insulation system classification by test instead of the traditional material descriptions. Several of the Subcommittees are promoting test programs which are expected to provide the data to support such new definitions.

Synchronous Machinery Subcommittee. The "Guide for the Operation and Maintenance of Turbine–Generators" has been approved by letter ballot of the Rotating Machinery Committee with no negative votes but with some editorial comments. We hope to have these resolved in time for action by the Standards Committee at its June meeting.

The working group on revision of the "Test Code for Synchronous Machines" has completed the technical portion of its work and is now preparing an edited draft suitable for letter ballot. As part of this work, it has prepared new definitions of positive sequence resistance and zero sequence resistance, and a revised definition for negative sequence reactance which have been approved and submitted to ASA Sectional Committee C42 for inclusion in the American Standard "Definitions for Electrical Terms."

Induction Machinery Subcommittee. This Subcommittee is studying the preparation of an induction machinery Application Guide which will serve as an authoritative reference for Standards and specification writers, and user engineers.

With the recent activity on re-evaluation and redefinition of insulating materials and systems, there have been a number of questions raised concerning other factors of induction motor design which are related to temperature rating, particularly in higher temperature motors. The Subcommittee is studying these and shortly will sponsor technical sessions and papers to promote fuller discussion and consideration of these matters.

The recent advent of electronic digital computers which can be applied practically to rotating machinery design is having a significant impact on induction machine design techniques. Certain empirical procedures which were practiced expediently, have given way to rational procedures for which computers can perform the intricate computations required. The Subcommittee sponsored at the Chicago 1956 Fall Meeting a series of sessions on the application of computers to induction machinery design. The Subcommittee is promoting additional technical papers activity in this field with the expectation that this will lead to more accurate performance calculations.

The rerating of induction motors by NEMA has occasioned a restudy by the AIEE Relay Committee of motor protection practices. The Induction Machinery Subcommittee is co-operating in this activity from the standpoint of providing consultation on, and interpretation of, motor design and performance characteristics.

D-C Machinery Subcommittee. A revision of the "Test Code for D-C Machines, AIEE No. 501," and a new "Guide for the Determination of Short-Circuit Characteristics of D-C Machinery" have been completed and have been approved by the Standards Committee. It is expected that they will be in print within the next few months.

At the request of the Power Generation Committee a new working group is being established to prepare an "Operation and Maintenance Guide for Shaft-Driven Exciters."

Single-Phase and Fractional-Horsepower Machinery Subcommittee. Because of conflicts with District meetings, the Special Technical Conference on application of small motors tentatively scheduled for 1957 had to be abandoned. It is hoped that the Dayton, Lima, or Fort Wayne Section can be interested in cosponsoring such a Conference in 1958.

The revision of the "Test Code for Single-Phase Motors, AIEE No. 502" has been approved by the Rotating Machinery Committee and has been submitted to the Standards Committee.

Insulation Subcommittee. The "Test Procedure for Evaluation of Systems of Insulating Materials for Random-Wound Electric Machinery," AIEE No. 510 and "Proposed Test Procedure for Evaluation of Systems of Insulating Materials for Electric Machinery Employing Form-Wound Pre-Insulated Coils," AIEE No. 511 were approved by the Standards Committee this year and are now in print. The proposed "Test Procedure for Evaluation of Insulation Systems for High-Voltage Rotating Machines" is temporarily at a standstill while test data is being accumulated.

The revision of the "Guide for Insulation Maintenance for Large A-C Rotating Machinery," AIEE No. 56 has been approved by letter ballot but one of the comments has not been satisfactorily resolved. We hope to have this resolved and the guide submitted to the Standards Committee in the near future.

Two new working groups have started work during the past year. One is preparing a revision of "Recommended Practice for Testing Insulation Resistance of Rotating Machinery," AIEE No. 43 and the other is preparing a "Guide for D-C Maintenance Testing of High-Voltage Rotating Machine Insulation."

Working Groups.

1. *Per-Unit Definitions.* At the last meeting, the working group reported that there are two widely used bases for per-unit quantities: electric input or output, and mechanical output. As of now, it appears that both bases would have to be recognized in order to come close to majority approval in the Committee.

2. *Measurement of Rotating Machine Noise.* This working group has made substantial progress toward the preparation of a test code for the measurement and evaluation of the noise of rotating electric machinery. The present trend of thinking is to measure the power level of the radiated sound from the machine, in each of eight separate octave bands, plus an over-all reading (unweighted) of total sound power level.

SUBSTATIONS COMMITTEE

The Substations Committee sponsored two technical sessions at the 1956 Summer and Pacific General Meeting in San Francisco and one technical session at the 1957 Winter General Meeting in New York.

Transmission Substation Subcommittee. This Subcommittee is continuing work on three projects that were previously undertaken. These are as follows:

Extra-High Voltage Substations. An interim report was presented by this Working Group at the 1956 Summer and Pacific General Meeting. The work is continuing, and a final report will be presented at some meeting in the near future.

Fire Protection and Minimizing Fire Hazards. This Working Group is nearing completion of its assignment and a report will be available for presentation soon.

Voltage Gradients through the Earth Under Fault Conditions. This Working Group has prepared a bibliography with brief abstracts of the literature on the subject which includes several foreign articles. The final report is now well under way and it is expected that it may be available for presentation at a technical session during the 1958 Winter General Meeting.

Distribution Substation Subcommittee. This Subcommittee is continuing work on three projects undertaken previously and, in addition, is starting on a new project. These are as follows:

Standardization of Factory-Designed Substations. This Working Group is continuing to keep the Committee advised of changes and proposed changes with respect to factory-designed substations. The Working Group also receives suggestions from the Committee members which are presented to the manufacturers.

Design and Utilization of Mobile Substations. This Working Group is preparing a report which summarizes the results of a questionnaire that was circulated among users of mobile substations. It is expected that the report will be ready for presentation at the 1958 Winter General Meeting.

Corrosion in Substation Grounding. This Working Group has prepared a bibliography with abstracts of the available literature and are continuing study of the subject with the intention of preparing a report which will be presented at a future meeting.

Location and Design of Substations. Formation of this Working Group was approved at the 1957 Winter General Meeting. This group will be responsible to study the problem pertaining to location, design, and operation of all types of substations, making reports to the Committee. It is expected that a suitable report for a technical session will result from these studies.

Conversion Substation Subcommittee. This Subcommittee has completed a report on "Recommended Grounding Practices for Single Polarity Direct-Current Structures." The report is scheduled for presentation as a Transactions paper at the Summer General Meeting in Montreal.

Automatic and Supervisory Control Subcommittee. This Subcommittee has completed revision of ASA C37.2—1945, "Automatic Station Control, Supervisory and Associated Telemetering Equipment." The revision has now been approved by the AIEE Standards Committee and the American Standards Association. It is expected that the new Standards will be available soon. This Subcommittee is also co-operating with the Supervisory Control Section of Report Revision Subcommittee of the Telemetering Committee in revising the supervisory control section of the AIEE 1948 Report on Telemetering, Supervisory Control, and Associated Circuits.

West Coast Subcommittee. This Subcommittee held two meetings on the West Coast during the year and was largely responsible for obtaining papers which were presented at the 1956 Summer and Pacific General Meeting in San Francisco. This Subcommittee is also obtaining papers for a joint technical session to be held during the 1957 Pacific General Meeting at Pasco.

West Coast Practices for Transil Oil Handling in Substations. This new Working Group was authorized to study the practices of West Coast utilities relative to the design, installation, operation, and maintenance of systems used for transil oil. It is expected that a report will be available for presentation in the near future.

SWITCHGEAR COMMITTEE

The Switchgear Committee has held two meetings in the past year; one on May 24th in Chicago and the other on November 1st in Washington, D. C. As usual, these meetings were held separate from the General Meetings and were well attended. By holding them on Thursday or Friday, provision is made for meetings of working groups and subcommittees on the two preceding days. A number of additional subcommittee and working group meetings have, of course, been necessary during the year but this plan has provided a very desirable three-day exclusive consideration of switchgear problems.

The Switchgear Committee sponsored three technical sessions at the 1957 Winter General Meeting and two technical sessions each at the 1956 Fall General Meeting and the 1956 Summer and Pacific General Meeting.

As will be seen from Subcommittee reports, a number of Subcommittee proposals have been approved by the Switchgear Committee and referred to the AIEE Standards Committee with the recommendation that they be adopted as American Standards. Three such proposals from the Power Circuit Breaker Subcommittee are quite important. They include important additional rating and capability requirements which the Switchgear Committee agrees are most desirable.

ASA Sectional Committee C37 has processed two switchgear items which have been published as American Standards. They are:

C37.16—1956. "American Standard, Schedule of Preferred Ratings for Alternating- and Direct-Current Low-Voltage Air Circuit Breakers."

C37.17—1956. "American Standard, Preferred Pickup Calibrations and Trip Delay Settings for Alternating- and Direct-Current Low-Voltage Air Circuit Breakers."

International Electrotechnical Commission (IEC) activities of the past year have been followed closely by the Switchgear Committee. The TC-17 Committee work on switchgear and control gear has been of major interest. Five United States delegates attended the Munich, Germany, meeting June 26th to July 12th. At the request of the AIEE Standards Committee, the Switchgear Committee was canvassed on a proposal concerning standardization of system voltages for TC-30 of IEC. Without a dissenting vote, the Committee approved the proposed system voltages of 345 kv nominal and 362 kv maximum.

Administrative Subcommittee. The Administrative Subcommittee has continued its efforts to co-ordinate the activities of other subcommittees. This work has been simplified by the splendid co-operation among subcommittees and the continual cross-flow of significant information. Of particular importance has been the careful co-ordination of activities concerning capacitance and capacitor switching as well as methods of rating.

Switches, Fuses, and Insulators Subcommittee. A principal activity of the Subcommittee during the past fiscal year has been the completion of the proposed revision of AIEE No. 22, "Air Switches, Insulator Units, and Bus Supports." After preliminary approval by this Subcommittee, the proposed revisions were extensively reviewed by the Switchgear Committee. Several changes were incorporated, an important one concerning the power factor of the load current interrupting rating of an interrupter switch. The final version has been approved by the Switchgear Committee and is now ready for submittal to the Standards Committee with the recommendation that it be published as an American Standard.

In similar manner, a proposed revision of AIEE No. 25, "Fuses Above 600 Volts," has been approved by the Switchgear Committee and will shortly be submitted to the Standards Committee. This revision will include some important changes in the Test Code.

The Working Group on Fuses 600 Volts and Below is well along on a proposed new standard covering cartridge fuses of the current-limiting and noncurrent-limiting types.

Other important Working Group activities concern Automatic Grounding Switches, Short-Circuit Rating of Fuses Above 600 Volts, and Capacitor Air Switches.

Power Circuit Breaker Subcommittee. Activities of the Working Group on Methods of Rating Power Circuit Breakers continue to be extremely important. This 19-man group has been very active. Four separate proposals have been given careful consideration. From the beginning, all of these have had important common ground. With a better understanding of each and some readjustment, the areas of agreement among the various proposed rating structures are growing. This gives reason to hope that final agreement on the most suitable method is not far off.

Two specific actions have been taken by this Subcommittee which are intended to speed up rating improvements and still permit whatever time is required for completion of this Working Group assignment:

1. Referred three important rating structure improvements to the Switchgear Committee as proposed immediate American Standard changes.
2. Set up a new Working Group to give full and immediate consideration on other proposed changes in the American Standards which are not covered by the Working Group on Method of Rating.

Three rating-structure improvements have been approved by the Switchgear Committee and referred to the AIEE Standards Committee as recommended American Standards material. They are:

C37.4-6.20.3, Breaker Conditions. Three-cycle breakers, 115 kv and above will be required to handle two standard duty cycles (rather than one).

C37.4-614, Rating Interrupting Times. New requirements are proposed for interrupting currents less than 25% of rating and for close–open operation.

C37.4-6.11, Rated Interrupting Currents. In some cases, rating is to include an increase of 15% for line-to-ground faults on grounded neutral systems.

Proposed standards for capacitance switching performance are being actively considered. In this work, careful consideration is being given to the capacitor switch proposals by the Automatic Line Sectionalizers and Automatic Circuit Recloser Subcommittees, and to a significant survey recently completed by the AEIC Committee on Electric Switching and Switchgear on switching capacitors and charging currents.

Other important docket items are: changes in the 4-second rating, and interrupting rating factors for reclosing service. These are under consideration by the EEI-AEIC-NEMA Joint Committee as well as this Subcommittee.

Low-Voltage Air Circuit Breaker Subcommittee. This Subcommittee presently has three working groups:

Calculation of Fault Currents in D-C Circuits. This Working Group on the preparation of a "Guide for Calculation of Fault Currents in D-C Circuits" has divided its work into 12 chapters. Several of these chapters are nearing completion and it is intended that they all be combined in one document as a reference book and guide for the calculation of fault currents in d-c circuits. Inasmuch as a great deal of the material being prepared by this Working Group is developmental in nature and has previously been unavailable to the industry, it is proposed to present each of these several chapters as papers in a symposium at the 1957 Summer General Meeting. This will make the material available to the industry and give an opportunity for discussion which should be helpful to the Working Group in completing its work.

Preparation of a Standard for Molded-Case Air Circuit Breakers. After review of the Subcommittee, the proposed "Standard for Molded-Case Air Circuit Breakers" is being rearranged. It should shortly be available for consideration by the Switchgear Committee.

Preparation of a Standard for Field Circuit Breakers for Synchronous Machines. Additions to the existing Standard for Low-Voltage Air Circuit Breakers are being considered to cover capacitance switching requirements. A new Working Group will also be established to study the basic rating of low-voltage air circuit breakers to see what might be done to place them on a symmetrical basis of rating.

Automatic Circuit Reclosers and Automatic Line Sectionalizers Subcommittee. Proposed AIEE No. 50, "Automatic Circuit Reclosers for A-C Distribution Systems," was approved by the AIEE Standards Committee and submitted to the ASA with a request that its material be incorporated in an American Standard. The Chairman of ASA Sectional Committee C37 has formed a Subcommittee to review this AIEE No. 50 and to co-ordinate it with NEMA Standard SG-13. The first meeting of this Subcommittee was held in Washington on November 2, 1956.

A proposed new AIEE Standard, "Capacitor Switches for A-C Distribution Systems," has been carefully reviewed with other Switchgear Subcommittees. Because of important common problem areas, the Power Circuit Breaker Subcommittee allotted considerable time during its October 31 meeting to discussion thereof. Comments and suggestions from all Subcommittees as well as from members of the Switchgear Committee are being worked into a final revision of this proposed standard.

Switchgear Assemblies Subcommittee. After considerable study and discussion both by this Subcommittee and the Switchgear Committee a new definition, Metal-Enclosed Load-Interrupter Switchgear, has been developed. It has been approved by the Switchgear Committee and submitted to the Standards Committee so that it can be referred to ASA for inclusion in American Standard C37.20, "Switchgear Assemblies and Metal-Enclosed Bus," and C42.

A "Guide for Evaluating the Effect of Solar Radiation on Outdoor Metal-Clad Switchgear" was published in October 1955 as a Committee Report (No. 955), for a one-year trial-use period. The Subcommittee has actively solicited comments, suggestions, or reasons for changing this report based on experience during the trial-use period. With suitable revisions, this guide will soon be submitted for Switchgear Committee letter ballot as a proposed Standard.

Adequate determination of what constitutes "flame retardant insulation" is difficult but important. Significant progress appears possible through the standardization of construction details of suitable test equipment.

SYSTEM ENGINEERING COMMITTEE

The System Engineering Committee naturally turned its attention to the areas associated with engineering planning for, operation of, and, in general, the efficient utilization of electric utility facilities.

Extensive studies by working groups within the Committee resulted in the presentation of three interesting reports; namely, one covering the effect of arc furnaces on power systems, another on the current status of load frequency control methods and a third giving forced outage rates on high-pressure steam turbines and boilers.

In the realization that many engineers are reluctant to make full use of digital computers, the System Engineering Committee and Computing Devices Committee launched an educational type of program in this field, starting with the general concept of the digital computer and working up to methods of application. As a continuation of this activity, plans are being developed for the publication of lists and descriptions of available computer programs, the objective being to avoid duplication of effort in this field.

The study of automatic control of generation is continuing, with particular emphasis toward allocation of generation to achieve maximum system economy. This emphasis is aimed at proper economic distribution from the point of view of generation, including the effect of transmission losses. A working group, joint with the Power Generation Committee is investigating the problems associated with the determination and application of incremental heat rates for load scheduling and load frequency control.

The methods of operations research and mathematical probabilities are receiving careful attention in the determination of utility system generation reserves. One of the problems is the presentation of this information in a form that can readily be understood and evaluated.

The System Engineering Committee is the place where actual problems of operation of electric utility systems are studied. These activities are given constant consideration and this study has resulted in some new ideas on the magnitude of tie-line bias obligation between interconnected systems.

TRANSFORMERS COMMITTEE

The Committee held two meetings during the past year. It sponsored technical session at the Summer and Pacific, Fall, and Winter General Meetings.

The work of the Committee is divided among seven Subcommittees; the following is a report of the activities of these Subcommittees:

Dielectric Tests Subcommittee. During the past year the following Working Groups have been active:

Power Factor Test Codes. The Working Group on Power Factor Test Codes has completed a Proposed Code for Power Factor Testing of Mineral Oil Insulated Instrument Transformers.

Guide for Impulse Testing. Work is continuing on a Guide for Impulse Testing. It is expected that real progress will be made on this Guide next year.

Revision to Dielectric Tests. Concurrently with the work on impulse testing, another Working Group is studying the entire dielectric tests part of the Test Code. This work has been divided into two parts: short-range changes and additions; and long-range projects, such as (1) development of a switching surge test, (2) possible modification of the low-frequency test voltages, and (3) corona testing.

Adequacy of Present Tests—Bushings. The Working Group on the Adequacy of Present Tests has been very active on the subject of transformer bushings, and final recommendations will be available in the near future.

Report Covering Need of Both Distribution and Power BIL. The question of the need for both power and distribution levels for certain equipment has been studied and may be published as a Committee Report.

The Subcommittee completed various dielectric test tables which were needed in preparing the American Standards in the new format.

Insulation Life Subcommittee. This Subcommittee is showing considerable progress in the preparation of formal Test Procedures for thermal evaluation of insulation systems for transformers. The Procedure for Thermal Evaluation of Ventilated Dry-Type Power and Distribution Transformers has been published for trial use as AIEE No. 65 (November 1956). Procedures for sealed gas-filled transformers, for liquid-immersed transformers, and for specialty transformers are in various stages of development.

Work is progressing satisfactorily on revising the short-circuit sections of the C57 Standards, on revising the Guide for Loading Oil-Immersed Distribution and Power Transformers" (ASA designation: Appendix C57.92), and on preparing a new "Guide for Loading Dry-Type Transformers."

Other items under consideration include a "Loading Guide for Furnace Transformers," methods for making temperature tests on dry-type transformers, methods for measuring ambient temperatures, and a review of short-circuit requirements for step-voltage and induction-voltage regulators.

Insulating Fluids Subcommittee. The proposed "Guide for Maintenance of Insulating Oils" has been approved by the AIEE Standards Committee, and has been published for trial use. The results of the questionnaire are nearly completed and will be analyzed, and material prepared for a suggested revision in the Guide in the near future.

The proposed guide for "Maintenance of Transformer-Type Askarel" is in the third draft stage. It is expected that the fourth and final draft will soon be completed.

Audible Sound Subcommittee. The Working Group on Technical Investigations has continued its work on methods for calculating noise versus distance, and will issue a report of two methods for making these calculations in the near future. Progress has been made on the use of wind screens on microphones as a possible means of coordinating readings between self-cooled and fan-cooled transformers. The results of the investigation will probably be published. Liaison has been established with the AIEE Standards Co-ordinating Committee No. 9 and with ASA Committees on Measurements and Instrumentation.

Performance Characteristics Subcommittee. This Subcommittee has one working Group which has been assigned the study of the use of impedance bridge methods for loss measurements in transformer testing, and has agreed: (1) to approve the inclusion in the American Standards for Transformers the use of impedance bridge methods as an alternate for the measurement of transformer losses; and (2) the name to be applied to this method will be "Impedance Bridge Method."

A Subcommittee report was submitted to the Transformers Committee which included recommended changes in the present Test Code and also a bibliography of references on Impedance Bridge Methods.

Standards Subcommittee. This Subcommittee has several Working Groups assigned to individual tasks. They are:

Furnace Transformers. This Working Group in co-operation with the Foundry Equipment Manufacturers Association

(FEMA) and NEMA groups, has assisted in the preparation of proposals for Furnace Transformer Standards, which includes standard kva ratings, standard voltage rating and taps, and the use of reactors and their connections. Considerable progress has been made toward standardizing the voltage and current ratings of the low-voltage winding.

Power and Distribution Transformers. The Working Group is considering a proposal to change the power factor of the load from 80 to 85% in the requirement for delivering rated output at 5% above rated voltage.

Regulators. This Working Group has prepared and circulated proposals for revisions in the Regulator Standards and Test Codes, including new sections on polarity and angular displacement.

Rectifier Transformers. This Working Group has prepared and circulated proposals pertaining to rectifier transformer connections, definitions, ratings, and Test Codes.

Dry-Type Transformers. This Working Group has prepared and is reviewing the latest draft of the "Guides for Loading Dry-Type Power and Distribution Transformers."

Constant-Current Transformers. This Working Group has circulated proposed revisions in the Standard and Test Codes for comments from the Working Group.

Instrument Transformers. This Working Group has reviewed the Test Code and assigned sections to the members to prepare revisions.

West Coast Subcommittee. This Subcommittee has no specific projects, but rather reviews and comments on work of the main Committee and the various Subcommittees. Several projects now active in other Subcommittees have been initiated at the suggestion of the West Coast Group, and other activities have received an impetus because of West Coast interest.

This group assists in arranging technical papers at West Coast meetings and in sponsoring transformer sessions at such meetings.

This Subcommittee holds at least two meetings each year. The most active interest in discussions centers on such items as bushing tests, impulse testing, switching surges, insulating levels in the higher voltages, transformer noise and vibration, and corona or ionization tests.

TRANSMISSION AND DISTRIBUTION COMMITTEE

The Committee held two meetings during the year. One of these was held at the time of the 1957 Winter General Meeting. The other was held in the Summer, apart from any AIEE session. The summer meeting of the Committee in Cincinnati was scheduled together with an inspection trip to the Clifty Creek Generating and Switching Station of the Ohio Valley Electric Corporation. The primary purpose of this station of 1.29 million kw capacity is to supply power to the Atomic Energy Commission's Portsmouth Project over the 345,000 volt transmission lines.

The Committee sponsored sessions and many technical papers at the Summer and Pacific, Fall, and Winter General Meetings.

Capacitor Subcommittee. Experience data is being accumulated on the volt-time characteristics of capacitors when subjected to severe overvoltage either by accident or by design, as for example, where Y-delta switching of capacitor banks is used. At present, there is insufficient data available to warrant a formal report.

A bibliography on capacitor literature for 1955 and 1956 is being compiled and will be submitted for publication. The subject of switched capacitors was discussed in a report entitled "Report of a Survey on Controls for Automatically Switched Capacitors."

Other active matters are the use of series capacitors with distribution transformers, concurrent operation of distribution feeder voltage regulators and switched capacitor banks, and the optimum use of lightning arresters with capacitor banks.

Distribution Subcommittee. Discussions are continuing on the subject of higher voltage distribution. Although studies indicate that economies are available in higher voltage distribution, there appears to be insufficient information, however, to compare performance on continuity of service with distribution at the lower voltage. Consideration is being given to the problem of developing uniform methods for reporting distribution troubles.

Time is being devoted to the study of the various means for improving the performance of distribution circuits. Among these are the smallest size wire to be used in minimizing interruptions due to wire failure; the use of porcelain transformer tanks under severe corrosive conditions; and the use of fiberglas crossarms and the elimination of crossarm braces to minimize pole fires in contaminated atmospheres.

The performance of lightning arresters installed on transformer tanks has undergone some study and is being explored further.

Plastic poles were reported in use on a trial basis.

General Systems Subcommittee. Switching surges are being studied, classified, and defined with the objective of specifying a typical switching surge for the evaluation of insulation characteristics. The emphasis on the subject of switching surges arises from the current trend of further reduction in insulation levels in the transmission voltage range coupled with improved characteristics of arresters. This trend has pointed up the relative importance of switching surges as compared with lightning surges and 60 cycle operating voltages on withstand insulation characteristics. A progress report on the studies being made was prepared and published, discussing and defining the nature of those switching surges which may occur on de-energization of capacitive kva for lines, cables, and capacitor banks. All studies were completed during the year on the manner in which arresters would limit and modify certain types of switching surges and on the nature of the arrester duty resulting from the discharge of these switching surges.

The phenomena pertaining to radio influence on high-voltage transmission lines is receiving a thorough investigation, particularly at high altitude conditions. The various factors which might have an effect on the phenomena have been itemized and related bibliographies have been compiled. During the year, from the many technical papers sponsored by the Subcommittee, explanations were obtained for several of the phenomena involved in the radio influence problem. One of these, in particular, was the complete accounting for the previously unexplained very large reduction in radio influence observed with multiple or bundle conductors.

A third activity of the Subcommittee pertains to the problem of arc deionization times on transmission lines. After a review of the current knowledge on the subject, the problem has been defined and two courses of action for its solution have been proposed.

Lightning and Insulator Subcommittee. Results from current large-scale lightning investigations are being reviewed. These investigations involve measurements on actual transmission lines in the field, also laboratory investigations, and analytical procedures. Special instruments have been developed for measuring the steepness of wave front of surges produced on transmission lines and towers. Investigations will furnish fundamental data on the nature of the voltages produced on transmission lines by lightning and will lead to improved performance on transmission lines in areas of intense lightning.

There is increasing interest in the use of multiple conductors in transmission line construction. This type of construction yields lower line reactance and improved corona and radio noise characteristics with smaller individual conductor sizes. Spreaders, corona shields, and special high-strength insulators have been developed for use on such high-voltage multiple-conductor spans.

Towers, Poles, and Conductors Subcommittee. There is an increasing need for reexamining the criteria of broken wire conditions used in connection with steel transmission line design. A proposed questionnaire on reduced broken wire assumptions is being completed and will be distributed to utilities for a reply.

Interest in underground corrosion of components of transmission and distribution facilities had developed to the point where a number of papers are available and sessions will be sponsored on the subject.

The life of wood poles, treatment of such poles, and the possible benefits to be expected from retreatment of wood poles continue to be subjects of lively discussion. Also, the question of the use of an all-aluminum conductor in the high-voltage field stimulates a lively discussion in the Subcommittee.

General. The Committee unanimously agreed to recommend that AIEE approve voltages of 345 kv nominal and 362 kv maximum, as proposed by Technical Committee No. 30 of IEC. The approval of these voltages was made with the understanding that they are to bear the same interpretations as those used in the lower voltages such as 230 kv nominal and 242 kv maximum in the tolerable zone.

The Committee has done considerable work in liaison with ASA Sectional Committee C2 which is working on the current revision of the National Electrical Safety Code. As a consequence of recent agreements on clearance requirements for lines exceeding 100 kv, ASA Sectional Committee C2 is now in a position to complete its assigned task.

Science and Electronics Division

BASIC SCIENCES COMMITTEE

The Basic Sciences Committee sponsored several (two to four) technical sessions at each of the three General Meetings held during 1956-57. Attendance at these sessions were disappointingly small; usually, between 15 and 35 persons were present. This has become a matter of concern to the Committee in its deliberations on how best to serve the profession and the Institute. Probably, the small attendance is caused by the diverse nature of many of the programs, and also because of conflicts with other sessions of similar interest which are run by other Technical Committees. For example, Basic Sciences often is in conflict with such Committees as Magnetic Amplifiers, Dielectrics, Computing Devices, and other committees that have basic sciences closely integrated into their subject matter. These scheduling difficulties may be related to the Subcommittee structure in the main Committee. For this reason, a motion was passed at the last meeting calling for a study of the Subcommittee structure.

With the exception of the Subcommittees on Magnetics and Electric Circuit Theory, subcommittee activities have been confined to reviewing papers and scheduling sessions at the several General Meetings.

Magnetics Subcommittee. This Subcommittee sponsored its usual annual Conference, which was held in Boston on October 16-18, 1956. The meeting was held in co-operation with the American Physical Society and the American Institute of Mining, Metallurgical, and Petroleum Engineers. An audience of approximately 1,100 heard the 77 technical papers that were on the program. Products were exhibited by 15 companies.

Electric Circuit Theory Subcommittee. This Subcommittee informally assisted in organizing the program of the 2nd Midwest Symposium on Circuit Theory, which was held in East Lansing, Mich., on December 3-4, 1956. This Conference was sponsored by the IRE and Michigan State University.

For two years, the Basic Sciences Committee has been attempting to sponsor a series of papers to be published in *Electrical Engineering* on the topic of "The Impact of Modern Physics on Electrical Engineering." All attempts to secure a prominent physicist as editor of such a series have failed. The search has been very extensive, and with its failure, it was decided at the last meeting of the Committee that the original plan is not feasible. A more informal plan is now to be followed, whereby the chairman of the Committee will do what he can to get appropriate papers on basic science topics to channel into *Electrical Engineering*.

During the year, the Basic Sciences Committee has continued to act as a sounding board for members of the Institute who hold controversial viewpoints on basic science concepts. Two such controversies have been under way.

As a result of action at the Committee meeting held in October 1956, contact was made with the Education Committee to see in what way the Basic Sciences Committee could assist in educational matters. As a first step, three representatives of the Basic Sciences Committee attended the meeting of the Education Committee at the 1957 Winter General Meeting.

COMPUTING DEVICES COMMITTEE

During the past year the Computing Devices Committee has continued to inform the members of the AIEE concerning engineering matters in the computing field and to represent the Institute in co-operative liaison with other technical computer interests. At each of the General Meetings during the year, the Committee sponsored several sessions, some in cosponsorship with other technical committees. Sessions and papers about computers and their applications were also presented at the District level.

Two Joint Computer Conferences, one on each Coast, were held under the joint auspices of the Institute of Radio Engineers, the Association for Computing Machinery, and the AIEE. The Eastern Joint Computer Conference in New York, held for three days in December, presented "New Developments in Computers," and the Western Joint Computer Conference in Los Angeles ran for four days in February, and covered "Techniques for Reliability." Papers of interest principally to computer specialists were presented at these Conferences. Plans are to continue with two Conferences each year.

The papers presented at the General Meetings were of more widespread interest to engineers, particularly to those having to do with applications in specific fields of electrical engineering. Many papers were of the Conference type, and the Committee is striving to obtain more Transactions papers.

The Computing Devices Committee functions through seven subcommittees, three of which deal with computing equipment, three with the broader aspects of the computing field, and one with all West Coast interests of the Committee.

The equipment subcommittees, i.e., Digital Computers Subcommittee, Analog Computers Subcommittee, and Analog-to-Digital Converters Subcommittee, were each represented by numerous papers which they secured and reviewed during the year.

Computer Applications Subcommittee. This Subcommittee has been successful in promoting a diversity of papers, and there appears to be a greatly increasing interest throughout the AIEE in topics within the scope of this Subcommittee.

Computer Bibliography Subcommittee. This Subcommittee finds its task beyond that of simple Subcommitte work. The Subcommitee was charged with the development of a bibliography on computers, but mushrooming growth of the field has resulted in publication of material about computers at such a rate that the mere cataloging and classification of them is a major undertaking. The Subcommittee presently is seeking a possible means of establishing an abstracting service financed by a grant.

Digital Computer Comparisons Subcommittee. This Subcommittee has found it difficult to establish common denominators for computers because of their great variety of properties and applications. The rapid introduction into the field of new features and computers with multiple and remote inputs adds to the difficulty.

West Coast Subcommittee. Sessions have been sponsored by this Subcommittee at the 1956 Summer and Pacific General Meeting and the group has promoted and assisted local Sections in establishing computer programs. This Subcommittee also furnished representation for the AIEE on the Western Joint Computer Conference.

In liaison activities, the Computing Devices Committee is proposing to establish a Computer Standards Subcommittee to work with the IRE and ASA in the field of standardization of computer terminology and symbols. The Committee maintains liaison with the Computer Application Subcommittee which operates under the System Engineering Committee and also with the Joint Division Committee on Automation and Data Processing. Liaison representation on the Standards Committee is maintained.

The Committee continues its efforts in behalf of promoting an international computer meeting during 1958. Such a meeting in Europe, perhaps in Paris, has been suggested and the Committee through its representative and with the co-operation of other technical societies is exploring the possibility of obtaining UNESCO support for such an enterprise.

The expansion of the computing devices field into many kinds of applications and into more widespread relationships with digital and cw data communications and with automation and control systems has prompted some thought concerning the possibility of a somewhat broader scope than that handled by the present Committee. The diversity of the activities of the Committee and the magnitude of its efforts have led to suggestions that the Computing Devices Committee might eventually constitute a Division. Some preliminary consideration is being given to this matter.

DIELECTRICS COMMITTEE

The Dielectric Committee has now been in existence as a full Committee in the Science and Electronics Division since August 1, 1955. It now has a total of seven Subcommittees: namely, Gaseous Dielectrics, Liquid Dielectrics, Solid Dielectrics, Thermal Evaluation of Insulating Materials, Corona Effects on Dielectrics, and the West Coast.

The principal activity of the Committee has been twofold: (1) to develop Standards wherever the need arises, especially, in the thermal evaluation of materials area; and (2) to sponsor papers and symposia at Institute meetings. In the latter area, a total of 35 papers were presented during the 1957 Winter General Meeting alone. The interest in these papers was considerable as attested by an attendance varying from 200 to 300 at all of the seven sessions sponsored by the Committee.

Thermal Evaluation Subcommittee. In the Standards area, this Subcommittee is particularly active and has contributed to a recent revision of AIEE No. 1 and, also, is in the process of developing a number of test procedures for the thermal evaluation of insulating materials. One of these, namely, the "Test Procedure for the Evaluation of the Thermal Stability of Enameled Wire" has already been issued as AIEE No. 57. Other test procedures on large magnet wire, fibrous-covered magnet wire, mica insulation, sleeving and tubing, rigid materials, flexible sheet materials, and varnishes are under way.

Radiation Effects on Dielectrics Subcommittee. This Subcommittee is active in the compilation of data on the changes induced by nuclear radiation in dielectric materials. It is also considering the development of a standard test procedure for determining the susceptibility of dielectric materials to radiation damage.

Gaseous Dielectrics Subcommittee. This Subcommittee is in the process of preparing a bibliography on the subject of Gaseous Dielectrics which will be published as an AIEE Special Publication. The Subcommittee, also, is giving active consideration to the development of a special test cell and procedure for evaluating gaseous dielectrics in general, and the newer electronegative gases, in particular.

Liquid Dielectrics Subcommittee. This Subcommittee is considering the problem of developing a test procedure for temperature classification of insulating liquids as well as the preparation of a special monograph on liquid dielectrics.

Corona Effects on Dielectrics Subcommittee. This Subcommittee is co-operating with other groups in developing test methods for measuring corona damage to dielectrics as well as measuring other corona parameters and quantities.

From the foregoing, it is apparent that the Committee has had a very successful year and plans for the future call for vigorous prosecution of the many projects now under way and the initiating of new ones where the need arises.

ELECTRICAL TECHNIQUES IN MEDICINE AND BIOLOGY COMMITTEE

The scope of AIEE activity in the field of medicine and biology was expanded during 1956 by the activation of the Air Pollution Subcommittee. The rapid increase of air pollution problems is recognized as of important significance within the scope of AIEE interests and of this Committee. Such problems will be spotlighted in technical sessions being planned by the Subcommittee for this year.

The Committee again sponsored, jointly with the Institute of Radio Engineers and the Instrument Society of America, a Special Technical Conference on "Electrical Techniques in Medicine and Biology," which was held in New York, in November 1956. This was the Ninth Annual Conference. It was a three-day program highlighted by a field trip to the Brookhaven National Laboratory and an evening session devoted to a lecture by Dr. L. S. Taylor, U. S. member of the International Commission for Radiation Protection.

The Committee also sponsored a technical session at the 1957 Winter General Meeting, consisting of a group of highly interesting papers on electromedical and electrobiological subjects. The increasing attendance at the sessions on Medicine and Biology at AIEE General Meetings in recent years is indicative of the growing interest of Institute members in this field.

For this year, a Tenth Annual Conference on Electrical Techniques in Medicine and Biology is being arranged, and is tentatively scheduled to be held in Boston in early November 1957.

ELECTRONICS COMMITTEE

During 1956-57 the Electronics Committee introduced the grade of Affiliate to its membership. Affiliate status was thereby assigned to all persons newly recommended for membership to one of the various active Subcommittees and to those present members of the Committee expressing a desire for an interested but inactive role in Committee affairs.

Executive Planning Group. Initial meetings of this group were held this year, concurrent with the national Committee quarterly meetings. Recommendations made at the close of the previous year were applied by this group to Committee activities and were reviewed prior to each Committee meeting. The Committee went on record as encouraging the promotion of special classified technical conferences cosponsored with the military. Standards for infrared devices and applications represent a typical present need for such activities.

Transformers for Electronic Applications Subcommittee. This new Subcommittee was activated under the chairmanship of H. W. Lord. It will handle the treatment of design, construction, and operation of transformers, reactors, and similar equipment as applied to circuits and systems which include electronic devices as circuit elements or as loads. Duplication of the functions of related technical committees within and without AIEE will be avoided by adequate liaison activity on the part of this group.

Prize Paper Subcommittee. The former Subcommittee with this name (which included the chairmen of all Electronics Subcommittees) has been revamped under the chairmanship of H. F. Dart. Each technical Subcommittee henceforth will review its own papers, passing only recommended prize papers along to the Prize Paper Subcommittee for action. This Subcommittee will no longer process Transactions papers; final action on these will be determined by each technical Subcommittee. Mr. Dart's Subcommittee will also act upon nominations for medalists as they are received from each technical group.

Representatives were appointed by the chairman of the Electronics Committee to establish liaison with the Division on Automation and Data Processing, the Education Committee, and the Professional Group of IRE on Electronics.

Attendance at the nine technical sessions conducted under the auspices of the Electronics Committee and its various Subcommittees throughout the year averaged 73 persons. A total of 36 papers were presented at these sessions.

Among the more noteworthy technical conferences sponsored by the Committee were the following:

The Third National Symposium on Reliability and Quality Control was cosponsored by the Electronics Committee through its Reliability and Quality Control Subcommittee, under the chairmanship of Victor Harris. It was very successful, and on the basis of attendance, a considerably increased participation on the part of the Committee is planned for the 1958 Symposium.

A very stimulating session on the training and upgrading of technicians for the engineering profession was presented at the 1957 Winter General Meeting by the Education in Electronics Subcommittee, under the chairmanship of C. F. Spitzer.

Plans for the coming year include technical sessions by eight of the subcommittees at the four national AIEE meetings and several cosponsored events of national significance.

MAGNETIC AMPLIFIERS COMMITTEE

Encouraged by the excellent attendance at the first Special Technical Conference and Exhibit on Magnetic Amplifiers held in April 1956, plans and arrangements are now being made to hold a second such Conference in Pittsburgh on September 4-6, 1957, and a third one in Los Angeles on August 6-8, 1958.

A Planning Subcommittee has recently been added to this Committee's organization. Its function is to co-ordinate the work of the several Subcommittees and to make long-range plans for the Committee as a whole.

Magnetic amplifiers are being applied to diverse fields of electrical engineering. Recognizing this situation, the Committee recently authorized the expansion of the Applications Subcommittee membership in order to enable it to form several Working Groups and thereby to provide more adequate coverage of the several fields of application.

West Coast Subcommittee. This group provided active support to the Magnetic Amplifiers technical sessions at the 1956 Summer and Pacific General Meeting in San Francisco. It was responsible for preliminary reviews of technical papers originating in that District and Subcommittee members presided at the sessions they sponsored.

Applications Subcommittee. As indicated in a foregoing paragraph, this Subcommittee is forming five Working Groups, one for concentrating on applications in each of the areas of (1) Magnetic Regulation and Servo Applications, (2) Magnetic Frequency Conversion, (3) Operational and Instrument Magnetic Amplifiers, (4) Static Magnetic Switching, and (5) Transistor–Magnetic Device Combinations. This Subcommittee expects to continue sponsorship of a session on Magnetic Amplifier Applications at the annual National Electronics Conference.

Definitions Subcommittee. After much discussion within the Subcommittee relative to categories into which various terms should be placed, a revised list of terms and definitions has been prepared. This list will be submitted to all Committee members in a form which will allow indication of approval of or disapproval of each term.

Those terms for which there is indicated complete agreement will constitute the body of a Transactions paper to be presented at the 1958 Winter General Meeting.

Standards Subcommittee. A progress report dealing with proposed rating methods, application data and test codes was presented as a paper at a technical session of the 1957 Winter General Meeting. Included in this report were proposed test codes for measurement of voltage and current amplification, response time, drift, and zero stability. This Subcommittee has given consideration to methods for specifying and/or measuring control circuit impedance, frequency response characteristics, and dynamic figure-of-merit.

Magnetic Amplifier Theory Subcommittee. The list of thesis projects in magnetic amplifiers was prepared by this group to stimulate interest in advanced technical work in this field. A list of 19 such thesis projects was published in the October 1956 issue of *Electrical Engineering*. By the end of December 1956, inquiries were received from 17 students, including one from India. A discussion type of meeting with invited guests was held during the 1957 Winter General Meeting. The subjects were "Properties of Thin Ferromagnetic Films and Frequency Multipliers." A most stimulating discussion followed the presentation of each subject by invited speakers.

Materials Subcommittee. A Working Group on Standardization of Toroidal Core Sizes of this Subcommittee completed their present work and presented the results in the form of a Transactions paper at the 1957 Winter General Meeting. The proposed Standards include two series of core sizes; one series of 11 sizes for low-gain applications and a second series of 11 sizes for high-gain applications. Also included are guides for determining future standard core dimensions. This Subcommittee's Working Group on Core Matching and Grading has nearly completed an extensive study of various methods presently used to match and grade cores. A proposed Standard based upon this study should be completed this year.

Planning Subcommittee. This new Subcommittee, consisting of the officers and preceding chairman of the main Committee and the chairmen of the Subcommittees, held its first and organizational meeting in March 1957. Indications are that it will serve a very useful function and provide an improved continuity of the work of the main Committee and of its Subcommittees. It was agreed that the normal procedure would be for the main Committee vice-chairman to become chairman of the Planning Committee for his second year as vice-chairman. This would enable him to formulate plans for Committee activities well in advance of his tenure as chairman of the main Committee.

NUCLEONICS COMMITTEE

This Committee continued its strong support and participation in the EJC Nuclear Engineering and Science Congresses with the chairman serving as AIEE Representative on the Program Committee for the 1957 Congress. The latter was held in Philadelphia, March 11-15, 1957, and proved to be highly successful as an effective forum for the presentation and interchange of technical, economic, and management information relating to all fields of nuclear science and engineering. Working with the Nucleonics and Radiation Instruments Committee, four sessions were organized for the Congress under AIEE sponsorship covering "Reactor Plant Operation and Maintenance," "Reactor Plant Instrumentation," "Reactor Control and Simulators," and "Reactor Instrument Development." These contained papers from AIChE, ASME, and IRE as well as AIEE and, thereby, provided excellent examples of cross-linking several technical disciplines in keeping with one of the primary objectives of the Congress.

The Nuclear Congress has now been established on a permanent basis with EJC as general co-ordinator and with AIEE as one of the founding societies. By providing the chairman of the Program Committee, the American Nuclear Society (ANS) is to play a central role in determining the technical program content of future Congresses. This will correct a major deficiency in the Congresses held to date in which ANS participation was essentially negligible. Plans for the 1958 Congress, to be held in Chicago March 1958 are already being developed by the Program Steering Committee on which the chairman of the Nucleonics Committee is again the AIEE representative. AIEE has also been assigned the role of co-ordinating society among ASME, IRE, ISA, and AIEE for contributions in the area of instrumentation for the 1958 Congress.

In its technical program sessions during 1956-57, the Committee has succeeded in covering essentially all of the areas following within its scope. At the San Francisco Summer and Pacific General Meeting, two sessions were held on "Nuclear Reactor Technology," both of which were well attended and served well in educating the Institute in this important area. One session on "Nuclear Machines" was held at the 1957 Winter General Meeting in New York, and two sessions on the "Effects of Radiation on Electrical Materials" are planned for the forthcoming Summer General Meeting in Montreal. The latter will be the first effort by the new Effects of Radiation on Materials Used in the Electrical Industry Subcommittee in sponsoring a technical session. In this instance, they have joined with the Dielectrics Committee in arranging the sessions in Montreal, in recognition of the close mutuality of interest with the latter Committee.

There is a growing need for more active participation by engineers in the formulation of appropriate State regulations on standards, safety codes, licensing, etc., in the atomic energy field. The comprehensive coverage given by AIEE to the general field of power-station design and operation, makes it especially appropriate that it play an important role in development of these regulatory actions on nuclear power plants. Accordingly, this subject and the desirability of establishing a new Subcommittee covering it will be one of the major topics at the next meeting of the Committee to be held in Montreal in conjunction with the Summer General Meeting. In this connection, too, a liaison representative has been designated to work with the Safety Committee in this field.

SEMICONDUCTORS—METALLIC RECTIFIERS COMMITTEE

The rapid advancement in the development of silicon rectifiers for the conversion of a-c power into direct current has stimulated the activities and expanded the size of both Subcommittees.

Semiconductor Devices Subcommittee. This Subcommittee reports that these devices permit building of rectifiers having a capacity of 500 amperes at 300 volts. Larger sizes and multiphase operations are being designed. The activities of this Subcommittee were primarily in the area of new definitions and testing methods.

Power Rectifiers Subcommittee. This Subcommittee expanded its personnel and activities to cover the new high-power sizes. Large blocks of power are being furnished using both silicon and germanium cells. One company alone installed 70,000 kw of capacity in 1955. New testing methods are needed for these large units. It is apparent that the trend is toward semiconductor-metallic rectifiers for power conversion applications.

Committee work continued on many technical problems, such as methods of measuring surge currents, inverse voltage surges, and methods of measuring the current-carrying capacity of the cell.

This Committee will continue to participate in the work of the IEC in formulating international standards on semiconductor rectifiers. Two members of this Committee will attend the International Meeting in Moscow, during July 1957.

SOLID-STATE DEVICES COMMITTEE

The major emphasis in the work of this Committee has continued to be standards and sponsorship of Special Technical Conferences. In the Standards field, "Test Code for Transistors," AIEE No. 425, has been approved by the Standards Committee and will be issued soon. The material included in the Test Code includes semiconductor definitions, letter symbols, small signal junction transistors, and methods of test for large signal applications of point contact transistors. Additional sections to this Test Code are in the course of preparation. These included graphical symbols (now being balloted on prior to submission to the Standards Committee), methods of test for large signal operation of junction transistors, and methods of test for diodes. Dates of submission of the latter two sections to the Standards Committee are uncertain at this time.

Two Special Technical Conferences are being supported. The Semiconductor Devices Research Conference is an annual event sponsored jointly with IRE. The Special Technical Conference on Solid-State Dielectric and Magnetic Devices will be held April 22-23, at Catholic University, Washington, D.C. This will be the first such Conference and is intended to provide a forum for new developments in the dielectric and magnetic devices field, such as the Semiconductor Devices Research Conference has provided in the semiconductor field. This, too, is jointly sponsored with IRE.

As in the past, activity of the Committee at the General Meetings has largely been tutorial. To this end, several sessions were sponsored at the Fall General Meeting and the 1957 Winter General Meeting in the semiconductor devices and dielectric devices areas to bring information to the membership on the state of the art and potentials of new devices.

Joint Subcommittee on Semiconductor Devices AIEE-IRE 28.4. This Subcommittee, together with the IRE Professional Group on Electron Devices, is responsible for conduct of the Semiconductor Research Conference. In its Standards work, the Subcommittee submitted the Test Code for Transistors to both AIEE and IRE for approval and has completed work on Semiconductor Graphical Symbols which is in process of approval in both societies.

Joint Subcommittee on Dielectric Devices AIEE-IRE 28.5. This Subcommittee, together with the Magnetic Devices Subcommittee, is sponsoring the Special Technical Conference on Magnetic and Dielectric Devices. The Subcommittee is completing its work on definitions and has instituted work on several other Standards.

Joint Subcommittee on Magnetic Devices AIEE-IRE 28.6. This Subcommittee has only recently been reorganized and is expected to become active in the Standards field in the near future.

RESEARCH COMMITTEE

The Research Committee has continued its study of where research efforts may be directed to advance the Institute or the electrical engineering profession. One of its major activities has been a co-operative effort with the Student Branches Committee and the Education Committee in supporting a survey of electrical engineering students' opinions of job opportunities which was undertaken by the Eta Kappa Nu Association in the Spring of 1956. Financial support was contributed to the survey by the Institute and a representative group of organizations interested in the electrical engineering profession.

The three AIEE committees sponsored a session at the 1957 Winter General Meeting to present the results of the survey and to present with other papers the views of some employers regarding engineering manpower problems.

The Committee believes there is great need for much longer range research efforts and research planning in various electrical fields. It is fully recognized that a large amount of developmental research is under way, but most of this applies to the relatively near future. It is also recognized that certain manufacturers and universities are active in some basic research efforts, but it seems that these efforts are not far-reaching enough. The Committee sponsored a session at the 1957 Winter General Meeting to consider this subject with papers to point out some of the problems and how they might be met. The session included a paper describing research activities of the electric power industry in Germany; this paper supplemented the ones of a year earlier that discussed the power industry research in England, Japan, Italy, and Sweden.

SAFETY COMMITTEE

The Safety Committee sponsored safety sessions at each of the three General Meetings of the Institute. Although the general interest subjects of grounding, electric shock, and resuscitation were prominently treated at such sessions, a series of papers dealing with the safety aspects of emergency lighting also were featured. In conjunction with the National Fire Protection Association, it is planned that these papers on emergency lighting be published in pamphlet form.

The third draft of "A Guide for the Presentation of Safety Programs by Student Branches" was approved with full expectation of distribution through the Student Branches Committee in time for use in the Fall Semester of 1957.

Efforts were continued toward collection of information on a national basis about electric shock fatalities. The U. S. Coroners' Association is co-operating with the Safety Committee in this project.

In order to increase the interest in electrical safety in the Technical Operations Department (TOD) Divisions, the Committee has undertaken the preparation of an outline of the scope of activities and responsibilities of the Division Liaison Representatives. It is expected that such material will assist the Liaison Representatives in promoting the consideration of electrical safety within the TOD Divisions.

A further effort at promoting electrical safety within the Institute has been an attempt to establish a channel of communication with an author at the time of preparation of a paper. Preliminary discussions along this line have been held with the Publications Department and the matter is receiving further study.

STANDARDS COMMITTEE

The Standards Committee appointed, during the past year, an Administrative Subcommittee which included a representative from each Technical Division for the purpose of maintaining continuing attention to standards work and clearing away details which should not be submitted to the Standards Committee as a whole.

The first draft of the report of the Procedure Subcommittee was referred to the Administrative Subcommittee. The Administrative Subcommittee has returned it to the Procedure Subcommittee for revision and the final report is expected to be ready by the Summer General Meeting.

The following AIEE publications have been approved:

62—Recommended Guide for Making Dielectric Measurements in the Field
64—Guide for Maintenance of Insulating Oil
65—Test Procedure for Thermal Evaluation of Ventilated Dry-Type Power and Distribution Transformers
66—Proposed Guide for Determination of Short-Circuit Characteristics of Direct-Current Machinery
501—Test Code for Direct-Current Machines
504—Test Code for Carbon Brushes
510—Test Procedure for Evaluation of Systems of Insulating Materials for Random-Wound Electric Machinery
511—Test Procedure for Evaluation of Systems of Insulating Materials for Electric Machinery Employing Form-Wound Pre-Insulated Coils

The following were approved for publication as Committee Reports:

952—Electric Power Distribution for Industrial Plants
953—Grounding of Industrial Power Systems

The following were approved for revisions of American Standards:

C34.1—Pool-Cathode Mercury-Arc Power Converters
C35.1—Rotating Electric Machinery Forming a Part of the Power Equipment on Electrically Propelled Railway Cars, Railway Locomotives, and Coaches (Trolley and Prime Mover)
C42—Definitions of Electrical Terms—Groups 10, 20, 25, 30, 35, 40, 41, 42, 43, 50, 55, 60, 65, 70, 80, and 85
Table 11.021 of C57.11 and Paragraphs 10.142 through 10.145 of C57.10-1948
Table 11.030 of C57.11
Y32.2.6—Graphical Symbols for Heat-Power Apparatus

Underwriters' Laboratories publications approved as Existing Standards:

(1) Electrically Heated Pads and Bedding
(2) Grounding and Bonding Equipment

Awards

EDISON MEDAL

The Edison Medal for 1956 was awarded to C. A. Adams, of Philadelphia, Harvard Professor Emeritus, ". . . for pioneering achievements in the development of alternating-current electric machinery and in electric welding; for vision and initiative in the formation of an engineering standards organization; and for eminence as an educator and consulting engineer," and presented to him on January 21, 1957, during the Winter General Meeting.

The medal may be awarded annually for meritorious achievement in electrical science, electrical engineering, or the electrical arts. Awards are made by a Committee of 21 members of the Institute.

CHARLES LeGEYT FORTESCUE FELLOWSHIP

The availability of this award was announced to the department heads of electrical engineering in all universities and colleges in the United States which offer accredited programs. The Committee decided to award one fellowship for the academic year 1957-58, carrying a stipend of $2,000. Applications received were 24 in number. Most applicants appeared to be well qualified for graduate level work.

The recipient for the 1957-58 award is Sigmund Scala, who is completing his bachelor of science degree at the University of Illinois, and will start the first year of his doctorate at Stanford University in the 1957 Fall semester.

JOHN FRITZ MEDAL

The John Fritz Medal may be awarded annually for notable scientific or industrial achievements by a Board of Award composed of representatives of the AIEE, American Society of Civil Engineers (ASCE), American Society of Mechanical Engineers

(ASME), and American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME). The 1957 medal was awarded to Ben Moreell, chairman of the board of the Jones & Laughlin Steel Corporation, with a citation, "Distinguished engineer and noted officer; builder of naval works in war, and in peace eminent industrialist and civic leader; devoted servant of church and country."

The medal was conferred upon Admiral Moreell on October 17, 1956, during the Annual Meeting of the American Society of Civil Engineers.

CHARLES FRANKLIN KETTERING AWARD

The Charles Franklin Kettering Award was established in August 1956, by the AIEE, Society of Automotive Engineers (SAE), ASME, ASCE, AIME, and American Institute of Chemical Engineers (AIChE). Its purpose is to recognize those who have have made creative accomplishments for the benefit of mankind, including discovery, invention, improvements in designs or processes within the relationships of materials and energy. The first award was made to Mr. Kettering himself.

The luncheon and ceremonies in connection with the establishment and presentation of the award were held on October 4, 1956, during the AIEE Fall General Meeting at the Morrison Hotel, Chicago.

LAMME MEDAL

The Lamme Medal for 1956 was awarded to H. H. Beverage, director of radio research, RCA Laboratories, Inc., New York, N.Y., ". . . for his pioneering and outstanding engineering achievements in the conception and application of principles basic to progress in national and world-wide radio communications." The medal will be presented to him on June 24, 1957, during the Summer General Meeting.

The medal may be awarded annually by a Committee of nine members to a member of the AIEE for ". . . meritorious achievement in the development of electric apparatus or machinery."

ELMER A. SPERRY AWARD

Established in 1955, the 25th anniversary of his death, the purpose of the Elmer A. Sperry Award is to encourage progress in the engineering of transportation and is awarded in recognition of ". . . a distinguished contribution which, through application, proved in actual service, has advanced the art of transportation whether by land, sea, or air." The recipient is chosen by a Board of Award representing the four engineering societies in which Sperry was most active: AIEE, ASME, SAE, and SNAME. The 1956 Award was presented to D. W. Douglas, president of Douglas Aircraft Company.

WASHINGTON AWARD

The Washington Award is conferred on one who, through accomplishment in engineering, has made pre-eminent contribution to the welfare of mankind.

The award is administered by the Western Society of Engineers on the recommendation of a Commission representing the AIEE, ASCE, AIME, ASME, and the Western Society of Engineers.

Several meetings of the Commission were held and balloting entered into to select a candidate for the 1957 award. W. L. Cisler, president of the Detroit Edison Company, received the necessary two-thirds vote of the members of the Commission and was, therefore, selected to receive the 1957 Award. Mr. Cisler accepted the award at a dinner meeting held jointly by the participating societies, April 22, 1957, at the Furniture Club of America in Chicago.

Representatives

ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT

Engineers' Council for Professional Development during 1956-57 has been under the leadership of M. D. Hooven following the completion of his term as President of AIEE. The annual meeting held in Detroit in October 1956 was significant for the variety of matters which came before the Council. These ranged from proposals of the Planning Committee for eliminating overlapping areas between ECPD and EJC, for activities in the area of ethics, proposals for the study of education law and problems relating to the model law, and for the consideration of applications from several societies for permission to join ECPD.

During 1957-58, the Education Committee under the chairmanship of Dean W. L. Everitt will give consideration to the evaluation of 176 engineering curricula in 58 institutions. About 90% of these will receive actual physical inspection by a team of approved inspectors drawn from the carefully selected list of available inspection team members. The results of this work are then acted upon by the Committee and the Council and are published annually under the title "Curricula Leading to First Degrees in Engineering in the United States." In this work of accreditation, close co-operation is continued with regional associations.

During the year, application for ECPD membership was received from the National Society for Professional Engineers. The initial action on this was favorable and the final approval on the petition is being reviewed by the supporting societies.

Other activities have been continued in the area of Student Development with particular concern to professional problems from the point of view of students, and the Training Committee which is concerned with developing improved programs for young engineers after college.

Representatives to the Conference of Engineering Societies of Western Europe and United States of America (EUSEC) under the chairmanship of Dean Thorndike Saville have been preparing for the third conference to be held in Paris in September 1957. This will cover engineering education in Europe and the United States beginning with preparatory schools, entrance requirements to engineering colleges, selective processes, and college level training. Other material will be exchanged on systems for providing practical working experience during the education process in the various countries, and also on the topic of professional recognition.

One of the most important activities being undertaken by ECPD is the project called Survey of the Engineering Profession. After careful consideration of this matter at Council meetings, funds have been made available by the member societies to undertake the preliminary work associated with this subject.

A special committee is working on the broader problem of the over-all survey and method of financing this, and considerable interest is being evidenced.

ENGINEERS JOINT COUNCIL

General Activities:

General Assembly: The Third EJC General Assembly was held on January 17-18, 1957, in New York, N. Y., with about 400 registering. The panel sessions included: "Problems of the Engineer in Government Service," "The Economic Status of the Engineer," "The Impact of the Engineer in International Relations." Proceedings of the Assembly are now available from EJC, 29 W. 39th St., New York, N. Y. EJC has given up its Fourth General Assembly in favor of a combined ECPD-EJC meeting—The Engineers' General Assembly—October 24-25, Hotel Statler, New York, N. Y.

Nuclear Congress: EJC co-ordinated the Second (1957) Nuclear Congress held in Philadelphia, Pa., March 11-14, 1957, sponsored by 24 leading engineering and scientific societies. including AIEE. Included was (1) Atomic Exposition with over 100 company exhibits, (2) Nuclear Science and Engineering Conference—Presentation of technical paper on nuclear science and engineering, (3) National Industrial Conference Board's Conference, and (4) Hot Labs Equipment Conference.

The success of the Congress was attested to by the registration of over 3,000 and more than 10,000 visitors to the Exposition. The Third Congress is now being planned for March 16-21, 1958, to be held in Chicago, Ill.

ECPD-EJC Survey of the Profession: A joint task committee of Engineers' Council for Professional Development and EJC has been appointed to design a specific program to be used to solicit support funds to conduct the most comprehensive survey of the engineering profession ever to be undertaken. The task committee will draw on funds appropriated by member societies to initiate the study. AIEE's proportionate share appropriated for this study is $10,000.

EJC Committees—Major Activities:

National Water Policy Panel: At the suggestion of N.W.P.P., a Review Board was established to summarize and update the "Principles of a Sound National Water Policy," published in 1951. EJC has just published the Review Board's 1957 Restatement of the Principles which is one of the most important policy statements on this crucial national problem.

Special Surveys: EJC published in January 1957 the most comprehensive report on engineering salaries available—Professional Income of Engineers, 1956—including salary structures for close to 110,000 engineers in industry, **Government, and education**. The data are broken down by specific employment activity, such as Electrical Machinery Manufacturing Industries, Telecommunication Services, Utilities, and Sanitary Services.

Practice of Engineering: The ECPD-EJC Joint Committee presented a report to the EJC Board of Directors on the recommended policy of the engineering profession on the practice of engineering as related to individuals, partnerships, and corporations. Because of the controversial nature of the subject matter, the report was referred to the constituent societies of EJC for review and comment. AIEE is expected to consider the report at its Board meeting on June 28, 1957.

Consulting Practice: A task committee is developing a report on "Principles of Consulting Practice" as a guide for clients and engineers. It is expected that the report will be presented to the EJC Board before the end of the year.

Air Pollution: This committee was developed to study the implications of air pollution as related to public welfare and the responsibility of the engineering profession thereto. It is completing the development of a policy statement for the profession, which is expected to be presented to the EJC Board this year.

Labor Legislation Panel: The Panel arranged for the filing of a brief as a "friend of court" before the U. S. District Court of the District of Columbia in support of a rule to enjoin the National Labor Relations Board from recognizing a group of professional engineers and nonprofessionals as a voting unit in collective bargaining determinations. EJC maintains this ruling misinterprets the law, and is contrary to the policy EJC supported at the time that the Taft-Hartley Act was modified to include the special provision for professional groups. The Court ruled in favor of the EJC stand but the case has been appealed to the U. S. Circuit Court of Appeals. EJC, through counsel, has again filed briefs as a "friend of court," continuing its support of the separation of professional engineers from technicians.

Engineering Manpower Commission: Continues its work in developing information and proof to establish the importance of engineering to the national economy, aiding in maintaining the supply and proper utilization of engineers, and counseling engineers on most effective means of completing military service obligations while contributing to professional development. The Commission continues to assist in the development and implementation of regulations for most effective training and utilization of military-age engineers.

The Engineering Manpower Commission published in 1956 a report on "Engineering Faculties"—containing data on the supply—demand and salary structure of engineering educational staffs. It also assisted the EJC Special Surveys Committee in conducting the annual survey on Demand for Engineering Graduates. The report of this survey served to point to the important trends in the demand for engineering manpower.

In May 1953, EMC released the report "Engineering Educational Facilities," with full data on estimated capacity, planned expansion, and enrollment of the nation's engineering colleges.

UNITED ENGINEERING TRUSTEES

J. H. R. Arms, secretary–general manager for many years, retired on December 31, 1956. He was succeeded by S. W. Marras who had been acting as his assistant since August 1, 1956.

New Headquarters Building. On June 22, 1956, the Special Task Committee of the Founder Societies and AIChE submitted their report and recommendation on the location of the new building. New York, N.Y., was selected, with a preference for the continued use of the present site. If rebuilding there proved impracticable another site in midtown New York was to be sought. The Committee further recommended that UET be expanded by the admission of AIChE, and that UET be authorized to raise money, accept the fund-raising offer of the group of industrialists and engineering educators, employ architects, engineers, and attorneys, and proceed with the reconstruction of the present building or the construction of a new building. The recommendation further provided that plans be made with ample optimism with respect to the future growth of these societies and that facilities should be such as to attract and hold the entire profession, thus fostering unity. All these recommendations were approved by the governing boards of the five societies.

Plans have been prepared for the enlargement, reconstruction and modernization of the present building with an addition to provide an entrance on 40th Street. Alternative plans have been prepared for a completely new building on the present site. These plans have been submitted to contractors for estimating and the estimates have been received. After careful consideration of cost and all other factors the Trustees have decided that reuse of the present site is not practicable. A new site in midtown Manhattan is actively being sought.

Plans are under way for raising funds from industry, society members, and other sources.

Engineering Societies Library. The library, a department of UET, was used by 43,000 persons during the year ending September 30, 1956, an increase of 7% over the previous year. Most of the business of the library is conducted by mail. Over 75,000 photo prints were supplied, an increase of more than 15%. Some 10,700 telephone inquiries were answered, and nearly 4,000 by mail. Income from paid services has doubled in the last 6 years. The number of volumes, maps, etc., in the library is now over 198,000. Reviews of 563 books were made, selected reviews being used by editors of eight publications. Operating revenue and expense approximated $150,000.

Engineering Foundation. During the year ending September 30, 1956, the Engineering Foundation, a department of UET, made grants for research projects, totaling over $70,000. Contingencies for eight projects totaled over $100,000 and estimated industry support will be at least $450,000. Following the death of the last beneficiary under the will of Edwin H. McHenry, who died on August 21, 1931, his entire estate, amounting to approximately $420,000, has been received by UET as a special trust fund for the furtherance of research in science and engineering, to be administered by Engineering Foundation.

There are three projects under the Engineering Foundation being sponsored by AIEE; namely, (1) Wood Pole Research, (2) High-Voltage High-Frequency Dielectric Phenomena, and (3) Thermal Resistivity Characteristics of Soils.

Joint Activities

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

During 1956, the following technical societies became affiliated members of Section M: (1) American Geophysical Union, (2) American Meteorological Society, (3) American Industrial Hygiene Association, (4) American Public Health Association, (5) American Society of Safety Engineers, (6) The Electrochemical Society, and (7) Tau Beta Pi.

Although 30 technical societies with a total membership of 150,000 are now affiliated with Section M, only about 3,000 engineers are registered members of the AAAS.

During the 1956 annual meeting in New York, Section M conducted a program devoted to the theme "Aids for Environmental Control." Attendance varied from 120 to 140, and 10 papers were presented at three sessions.

Major efforts of Section M will continue to be devoted to making the AAAS a medium of the discussion of the many related problems of pure and applied science.

AMERICAN STANDARDS ASSOCIATION

AIEE serves as sole sponsor for 9 standards projects under ASA sectional committee procedure. Revisions of the following 3 standards included in these projects were completed during the past administrative year: Pool Cathode Mercury-Arc Power Converters, Rotating Electric Machinery on Railway Locomotives and Rail Cars and Trolleys, Gasoline-Electric and Oil-Electric Coaches, and Lightning Arresters for Alternating-Current Power Circuits. Fourteen groups of the revision of the Definitions of Electrical Terms have been completed. The Institute is also joint sponsor with other organizations for 3 ASA projects. In all, it is represented on 64 sectional committees under ASA procedure.

The scope of the project on measurement of high voltage, for which AIEE is sponsor, was recently enlarged to include basic testing techniques. The American Standard for Wet Tests, which was developed originally by AIEE, will be revised in this committee.

Preparations for standardization in the nuclear field are being made in the recently formed ASA Nuclear Standards

Board on which the Institute is represented. Six sectional committees are being organized to cover: (1) General and Administrative Standards for Nuclear Energy, (2) Nuclear Instruments, (3) Electrical Requirements for Reactors and Nuclear Power Systems and Generator and Application of Nuclear Radiation, (4) Chemical Engineering in the Nuclear Field, (5) Reactor Hazards, and (6) Radiation Protection. AIEE will serve as joint sponsor with NEMA for the third project and has offered its services as sponsor for the second project.

A number of proposed revisions in the American Standards for (1) Transformers and (2) Switchgear were developed in AIEE Technical Committees and submitted to ASA.

With respect to "Electrical Definitions" the ASA Electrical Standards Board approved a procedure (CE 417) for the handling of electrical definitions when submitted independently by various committees or organizations, with the objective of avoiding the approval of conflicting definitions as American Standards and to secure correlation with the project on "Definitions of Electrical Terms," for which AIEE serves as sponsor under ASA procedure. The adoption of this procedure brought to a conclusion one of the last efforts of the late Charles Rufus Harte who served as chairman of the ASA Electrical Standards Board since its formation in 1931. During his long service to AIEE and ASA he was instrumental in bringing together the various interests and resolving many such jurisdictional problems.

Mr. Harte was awarded the Standards Medal by ASA at its annual meeting in October 1956, having been recommended for this honor by the AIEE Standards Committee as early as 1952.

It may be of interest to readers who have not closely followed the development of the organizations that are active in standards work that AIEE was one of the five technical societies that formed the American Engineering Standards Committee in 1918, the name later being changed to American Standards Association.

GENERAL ELECTRIC EDUCATIONAL AND CHARITABLE FUND FELLOWSHIP COMMITTEE

This fund offers fellowships to degree holders from United States universities and colleges for continued advanced study. A Committee of 10 representatives of engineering and scientific societies and educational institutions met on March 29, 1957, to consider 340 applications for graduate fellowships, following advance review of qualifications in digest form. Award of 34 fellowships were made, of which 28 are offered in physical sciences, engineering, and industrial management; and 6 in arts and sciences, law, and business. Continuance from year to year is not automatic. Alternates are also selected so that all fellowships are finally awarded.

Electrical engineering recipients include: (1) R. B. Ash, Columbia University; (2) E. R. Hattendorf, University of Illinois; (3) R. E. Levin, Stanford University, and (4) J. D. Schoeffler, Case Institute of Technology (to study at Massachusetts Institute of Technology).

UNITED STATES NATIONAL COMMITTEE OF THE INTERNATIONAL ELECTROTECHNICAL COMMISSION

The electrical industry of the world, represented by 700 delegates, concluded 10 days of work on international electrical standards on July 6, 1956, in Munich, Germany.

Seven new recommendations of the International Electrotechnical Commission (IEC), the world's standardizing body in the electrical field, were authorized for publication by the organization in the interest of promoting international trade. There were 16 draft recommendations accepted for circulation to the National Committees of the 32 nations of IEC and 8 revised draft recommendations authorized for final circulation.

The United States National Committee (USNC) of IEC, an arm of the American Standards Association, was represented at the meetings (June 29–July 6) by 51 delegates including the following USNC officers: R. C. Sogge, manager, General Electric's Engineering Standards, president USNC; Vice-Admiral G. F. Hussey, Jr., USN (Ret), managing director, American Standards Association, treasurer USNC; J. W. McNair, acting technical director, American Standards Association; and S. D. Hoffman, in charge of the electrical department of ASA, and secretary USNC. Dr. H. S. Osborne, retired chief engineer, American Telephone and Telegraph Company, and former president of the IEC, attended as a delegate-at-large.

C. H. Linder, vice-president–engineering, General Electric Company, highlighted the meeting with the second Charles LeMaistre Memorial Address, a lecture established to bring before the IEC annually a prominent international figure in the electrical field. Mr. Linder took as his subject "Standardization, Virtue and Necessity."

Among the agreements reached at the meetings was the formal adoption of the name "Tesla" for the unit of magnetic flux density in the Giorgi (MKS) system.

As the centenary of the birth of Nikola Tesla was being held in Belgrade, Yugoslavia, during July, the IEC sent the following message: ". . . It is always with a sense of profound respect and admiration that Tesla is remembered throughout the electrical world, and the IEC is mindful that its work today for international agreement in the electrical field is dependent to a very large measure on the fundamental scientific work of Nikola Tesla. The IEC is very happy that the fact has been marked this year by the agreement it has reached."

The IEC Committee on Aluminum brought before the group three draft specifications which were agreed upon and which will be published as IEC Recommendations. They deal with aluminum alloy electric conductor wire of the Al-Si-Mag type, commercial hard-drawn wire, and aluminum bus bars.

A draft specification for galvanized steel wire for reinforcement of aluminum steel conductors, including requirements for zinc coating, was authorized by IEC to be circulated to the national committees to be studied and voted upon.

A new international committee, which will operate as a subcommittee of IEC Technical Committee 2 on Rotating Machinery will deal with carbon brushes for rotating machinery. Also approved were new proposals on standard rating of 50-cycle steam turbines, together with steam pressures and temperatures.

In the radio-communications field, a highly valued document was authorized for publication as an IEC Recommendation, "Recommended Methods of Measurement on Receivers for Frequency Modulation Broadcasting Transmissions." Another document on radiation measurements was accepted for circulation. At the end of a six-month study period by the national committees, the IEC will act on the final form by approving it as a Recommendation.

The national committees having acted in favor of a document on the method of test for volume and surface resistivities of insulating materials, the IEC Committee of Action accepted it as an IEC Recommendation. Another document on primary cells and batteries was also approved by the Commission for publication.

R. C. Sogge, president of the USNC, at the request of the IEC, presented a survey of what is being done in the field of automation in the United States. The information was directed toward helping ". . . provide the proper understanding and to serve as a basis for making a decision on what standardization is desirable and what could be done most effectively by IEC."

Mr. Sogge told the group: "Automation requires a large overhead investment. Whether such an investment can be justified or not will be determined by the volume of identical parts of products to be manufactured. Standardization is the key to automation."

A statement on the peacetime uses of atomic energy prepared for the United Nations pointed out that the IEC is considering how the development of nuclear fission in industry affects electric equipment, components, and electronic instruments.

The organization stated that it wished ". . . to make clear its anxiety to press forward in these fields and eventually in others where the need arises, to help forward the development of nuclear power by such action."

The 1957 meeting of the IEC will be held in Moscow, where delegates will be guests of the USSR National Committee of IEC from July 2-12. Sweden's invitation to meet in Stockholm in 1958 has been accepted.

The International Electrotechnical Commission, which develops standards in the fields of electrical engineering and communications, is a federation of the national committees of 32 countries. The Commission endeavors to promote understanding among the electrical engineers, scientists, government officials, and industrialists of its member countries in order to further world trade.

UNITED STATES NATIONAL COMMITTEE WORLD POWER CONFERENCE

The United States National Committee, with the assistance of a Reviewing Committee, approved and submitted 10 papers for presentation at the Belgrade, Yugoslavia, Sectional Meeting, which will be held June

5-10, 1957. The vice-chairman of the United States National Committee was appointed chairman of the U.S. National Committee's delegation. He was authorized to appoint three other delegates as U. S. Representatives at the International Executive Council meetings during 1957 and to organize the United States participation in the Technical papers discussion at Belgrade.

Participation in the 1958 Sectional Meeting in Montreal was approved and the chairman and vice-chairman were authorized to appoint a Committee on Papers and a Committee on Tours for this meeting.

The United States National Committee and Executive Board met in New York City on January 16, 1957. The treasurer submitted the financial report for the year ending December 31, 1956, and it was approved. The Finance Committee which was appointed at the January 20, 1956, meeting submitted a report indicating the necessity of obtaining a yearly contribution of $1,500 from the Participating Members in Group A and recommended that this amount be divided among the five societies in proportion to the dues income of each. The AIEE assessment amounted to $444. The recommendation of the Finance Committee was approved and the representatives of each Participating Member of Group A was requested to convey this action to his society. Subsequent to this action, the AIEE Board of Directors approved the payment of this $444.

The reprinting of the Articles of Association and By-laws was approved. The revised copy will include all changes which were recommended by the Task Group appointed at the January 20, 1956, meeting.

Appreciation

The Board of Directors wishes to record its appreciation of the continuing excellent work of the Departments, general committees, technical divisions and committees, and District, Section, and Branch officers and committees. It also expresses its thanks to the membership for the widespread interest and participation in the activities.

Respectfully submitted for the Board of Directors.

N. S. Hibshman

Secretary

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

Exhibit A

Balance Sheet, April 30, 1957

ASSETS		
Property Fund Assets:		
Founder's interest (one fourth) in capital assets of United Engineering Trustees, Inc.:		
Land, buildings, and equipment (less funded depreciation and renewal reserve)	$215,983.73	
Funded depreciation and renewal reserve	282,464.75	
TOTAL	$498,448.48	
Other (at nominal value):		
Library	1.00	
Works of art, etc.	15.00	
TOTAL PROPERTY FUND ASSETS		$ 498,464.48
Restricted Fund Assets:		
Securities—at cost (quoted market value $1,331,792) Schedule 1	$987,715.50	
Cash	12,715.08	
Accrued interest purchased	164.01	
Receivable from broker—due on securities sold	1,774.48	
TOTAL RESTRICTED FUND ASSETS		1,002,369.07
Operating Fund Assets:		
Cash	$220,665.41	
Accounts receivable:		
Members—for dues	46,375.85	
Advertisers	7,242.88	
Subscribers to *Transactions*, etc.	37,864.78	
Inventories—at cost or less:		
Transactions	17,844.00	
Text and cover paper	32,156.44	
Badges	3,560.92	
Production charges for May and subsequent issues of *Electrical Engineering*	22,985.76	
Prepaid expenses	5,819.12	
Office furniture and fixtures (less reserve for depreciaiton, $58,321.33)	39,748.57	
TOTAL OPERATING FUND ASSETS		434,263.73
TOTAL		$1,935,097.28

LIABILITIES		
Property Fund Reserve:		
Founder's interest (one fourth) in capital assets of United Engineering Trustees, Inc.:		
Land, buildings, and equipment (less funded depreciation and renewal reserve)	$215,983.73	
Funded depreciation and renewal reserve (marketable securities and cash held by United Engineering Trustees, Inc.)	282,464.75	
TOTAL (UNCHANGED DURING THE YEAR)	$498,448.48	
Other	16.00	
TOTAL PROPERTY FUND RESERVE		$ 498,464.48
Restricted Fund Reserves (Exhibit C):		
Reserve capital fund	$926,077.32	
Members-for-Life fund	25,727.61	
International Electrical Congress of St. Louis Library fund	6,610.39	
Edison Medal fund	10,293.46	
Edison Endowment fund	8,082.17	
Lamme Medal fund	9,601.33	
Mailloux fund	1,039.65	
Volta Memorial fund	13,753.04	
Kettering Award fund	1,184.10	
TOTAL RESTRICTED FUND RESERVE		1,002,369.07
Operating Fund Reserve, Liabilities, Etc.:		
Accounts payable	$ 97,956.92	
Accrued expenses	14,611.89	
Deferred income, etc:		
Dues (including $46,375.85 uncollected)	63,530.77	
Subscriptions to publications, etc. (including $24,651.24 uncollected)	55,626.64	
Other	4,150.08	
Operating fund reserve (Exhibit B)	198,387.43	
TOTAL OPERATING FUND RESERVE, LIABILITIES, ETC.		434,263.73
TOTAL		$1,935,097.28

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

Exhibit B — Statement of Income and Operating Fund Reserve for the Year Ended April 30, 1957

Income:		
Dues:		
Members	$818,137.66	
Students	39,213.15	
Fees:		
Entrance	21,125.50	
Transfer	3,540.00	$ 882,016.31
Publications sales:		
Advertising	$534,860.56	
Electrical Engineering subscriptions, etc.	47,308.46	
Transactions volumes	37,485.05	
Bimonthlies subscriptions, etc.	22,811.63	
Preprints, special and technical publications, etc.	76,576.54	719,042.24
Other income:		
Meetings registration fees	$ 45,985.79	
Technical conference—net	11,859.45	
Interest and dividends on investments of Reserve Capital Fund	38,882.11	
Standards sales (including binders)	20,337.25	
Members emblems	643.81	
Miscellaneous	275.03	117,983.44
TOTAL INCOME		$1,719,041.99
Expenses:		
Committees:		
Membership	$ 33,265.32	
Planning and co-ordination	7,057.54	
Public relations	39,908.14	
Standards	35,675.68	
Technical	32,192.95	
Constitution and bylaws	2,360.17	
Finance	1,650.00	
Other	1,064.95	$ 153,174.75
Outside Activities:		
Engineers' Joint Council	$ 9,422.67	
Engineers' Council for Professional Development	4,827.50	
American Standards Association	2,624.50	
National Council of State Boards of Engineering Examiners	500.00	
World Power Conference	444.00	
Canadian Radio Technical Planning Board	25.00	
Commerce and Industry Association of New York	100.00	
U. S. National Committee—International Commission on Illumination	300.00	
Engineers' Foundation—Welding Research	250.00	
National Fire Protection Association	100.00	
Miscellaneous	(34.92)	18,558.75
Forward		$ 171,733.50
TOTAL INCOME (Forward)		$1,719,041.99
Expenses (Forward)		$ 171,733.50
Institute Districts		6,803.66
Institute Sections		152,171.77
Institute Branches		50,852.54
Institute Meetings		62,270.48
Publications:		
Electrical Engineering:		
Text	$217,243.47	
Advertising	279,637.49	
Transactions volumes	45,276.76	
Bimonthlies	144,740.83	
Year Book	7,931.28	
Preprints, special and technical publications, etc.	98,372.23	793,202.06
General and Administrative:		
Salaries	$146,098.96	
Postage	6,007.58	
Stationery and supplies	13,291.71	
Retirement system—AIEE—normal contribution, etc.	16,644.27	
Social security taxes	6,260.35	
Depreciation of furniture and fixtures	5,480.06	
Legal fees	500.00	
United Engineering Trustees:		
Building assessments (exclusive of $4,397.69 charged to other accounts)	29,984.28	
Library assessments	19,493.70	
Library pension	4,831.25	
Travel expenses of Directors and President	21,984.32	
Miscellaneous	24,986.70	295,563.18
TOTAL EXPENSES		$1,532,597.19
Excess of Income Over Expenses for the Year		$ 186,444.80
Operating Fund Reserve, May 1, 1956		214,217.63
		$ 400,662.43
Transfer to Capital Fund Reserve (Exhibit C)		202,275.00
Operating Fund Reserve, April 30, 1957		$ 198,387.43

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

Exhibit C **Statement of Restricted Fund Reserves for the Year Ended April 30, 1957**

	Total	Reserve Capital Fund	Life Membership Fund	Members-for-Life Fund	International Electrical Congress of St. Louis Library Fund	Edison Medal Fund	Edison Endowment Fund	Lamme Medal Fund	Mailloux Fund	Volta Memorial Fund	Kettering Award Fund	Retired Employees' Insurance Fund
Balance, May 1, 1956	$ 794,245.96	$705,037.54	$5,434.77	$23,431.06	$6,608.09	$ 9,998.17	$8,146.04	$9,515.78	$1,038.85	$15,035.66		$10,000.00
Additions:												
Transfer from operating fund reserve (Exhibit B)	202,275.00	202,275.00										
Transfers between restricted fund reserves		15,151.55	(5,151.55)			256.37	(256.37)					(10,000.00)
Income from investments	2,446.44	*	68.75	487.50	137.50	900.00	192.50	345.00		315.19		
Interest on bank balances	25.36		2.56						22.80			
Dues paid by Members-for-Life	6,265.76			6,265.76								
Contributions:												
Received from C. G. Bailey	1,159.10										$1,159.10	
Other	222.00			197.00							25.00	
Profit (loss) on sale of securities	3,515.42	3,613.23								(97.81)		
TOTAL	$1,010,155.04	$926,077.32	$ 354.53	$30,381.32	$6,745.59	$11,154.54	$8,082.17	$9,860.78	$1,061.65	$15,253.04	$1,184.10	
Deductions:												
Authorized withdrawal from Life Membership Fund	$ 354.53		$ 354.53									
Purchase of medals, certificates, cost of engraving etc.	2,848.68			$ 1,766.18		$ 823.05		$ 259.45				
Library purchases	157.20				$ 135.20				$ 22.00			
Traveling expenses—District Branch prize winners	2,864.20			2,864.20								
Scholarship awards	1,500.00									$ 1,500.00		
Cable charges, stationery, etc.	61.36			23.33		38.03						
TOTAL DEDUCTIONS	$ 7,785.97		$ 354.53	$ 4,653.71	$ 135.20	$ 861.08		$ 259.45	$ 22.00	$ 1,500.00		
Balance, April 30, 1957 (Exhibit A)	$1,002,369.07	$926,077.32		$25,727.61	$6,610.39	$10,293.46	$8,082.17	$9,601.33	$1,039.65	$13,753.04	$1,184.10	
Composition of Balances:												
Investments (Schedule 1)	$ 987,715.50	$923,728.89		$19,674.22	$5,031.25	$ 9,131.25	$7,827.45	$8,932.44		$13,390.00		
Receivable from bank—due on securities sold	1,774.48	1,774.48										
Accrued interest purchased	164.01	164.01										
Cash in banks	12,715.08	409.94		6,053.39	1,579.14	1,162.21	254.72	668.89	$1,039.65	363.04	$1,184.10	
TOTAL	$1,002,369.07	$926,077.32		$25,727.61	$6,610.39	$10,293.46	$8,082.17	$9,601.33	$1,039.65	$13,753.04	$1,184.10	

*The income of $38,882.11 from Reserve Capitol Fund investments is credited to operating fund income (see Exhibit B).

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERING

Schedule 1 Restricted Funds—Securities Owned, April 30, 1957

Name of Issuer and Title of Issue	Principal Amount	Book Value	Market Value
Reserve Capital Fund:			
Bonds:			
Public utility bonds:			
American Telephone & Telegraph debentures:			
2¾%, due 1971	$20,000	$ 19,650.00	$ 17,350
2¾%, due 1975	15,000	15,093.75	12,488
3⅞%, due 1990	20,000	20,475.00	19,350
Pacific Gas & Electric first refunding:			
Series K 3%, due 1971	20,000	18,417.50	18,250
Series L 3%, due 1974	5,000	4,643.75	4,456
Philadelphia Electric, first refunding 2¾%, due 1967	30,000	29,637.50	27,600
TOTAL PUBLIC UTILITY BONDS		$107,917.50	$ 99,494
Industrial bonds:			
Duke Power, 3⅝% mortgage bond, due 1986	$25,000	$ 25,625.00	$ 24,312
General Electric, 3½% debentures, due 1976	25,000	25,562.50	24,250
General Motors, 3¼% debentures, due 1979	25,000	24,875.00	23,188
Shell Union Oil, 2½% debentures, due 1971	25,000	24,212.50	21,500
Socony Vacuum Oil, 2½% debentures, due 1976	30,000	27,730.00	26,138
Standard Oil of New Jersey, 2⅜% debentures, due 1971	20,000	19,675.00	17,200
TOTAL INDUSTRIAL BONDS		$147,680.00	$ 136,588
Dominion of Canada, Externals 3%, due 1963	$10,000	$ 10,050.00	$ 9,750
United States Government bonds:			
Treasury bonds:			
2¾%, due September 15, 1961	$30,000	$ 29,793.76	$ 29,006
2½%, due August 15, 1963	40,000	38,750.00	37,575
2½%, due December 15, 1972-67	35,000	34,814.06	31,347
Savings bonds series G 2½%:			
Due, October 1, 1957	30,000	30,000.00	29,760
Due, May 1, 1961	30,000	30,000.00	28,920
Due, July 1, 1961	15,000	15,000.00	14,460
TOTAL U. S. GOVERNMENT BONDS		$178,357.82	$ 171,068
TOTAL BONDS (Forward)		$444,005.32	$ 416,900
	Number of Shares		
Capital stocks:			
Preferred stocks:			
Atchison, Topeka & Santa Fe Railway 5% noncumulative	2,000	$ 19,174.71	$ 20,500
General Motors $5	200	25,820.00	22,300
Ohio Edison 4.40%	200	21,279.25	18,850
Public Service Electric & Gas, $1.40 dividend preference common stock	600	17,253.74	16,350
Scovill Manufacturing, 3.65%	100	10,111.25	8,200
United States Steel, 7%	100	14,885.00	14,450
TOTAL PREFERRED STOCKS		$108,523.95	$ 100,650
Common stocks:			
American Cyanamid	400	$ 29,469.32	$ 31,650
American Gas & Electric	1,000	13,594.68	38,750
American Telephone & Telegraph	330	56,371.34	58,657
Caterpillar Tractor	600	13,283.36	54,375
Christiana Securities	5	34,625.00	70,500
Eastman Kodak	330	7,524.94	31,391
General Electric	650	9,924.77	41,194
General Motors	600	4,235.53	25,575
International Paper	210	8,125.64	20,528
James Lees & Sons	500	16,217.32	17,438
Louisville & Nashville Railroad	100	6,278.13	7,675
Minneapolis-Honeywell Regulator	200	17,237.16	18,750
Monsanto Chemical	200	6,176.66	7,050
Pacific Gas & Electric	400	17,623.57	19,400
Royal Dutch Petroleum	750	33,888.75	35,906
Sears, Roebuck	900	4,422.78	23,625
Socony-Mobil Oil	550	10,421.18	31,556
Standard Oil of Indiana	500	22,676.06	26,750
Standard Oil of New Jersey	1,213	9,910.35	73,083
Texas Utilities	600	9,780.29	29,175
Union Carbide & Carbon	300	7,277.42	34,725
Virginia Electric & Power	300	13,725.57	14,850
Westinghouse Electric	400	18,409.80	23,650
TOTAL COMMON STOCKS		$371,199.62	$ 736,253
TOTAL CAPITAL STOCKS		$479,723.57	$ 836,903
TOTAL (Forward)		$923,728.89	$1,253,803

Schedule 1 **(Continued)**

Name of Issuer and Title of Issue	Principal Amount or Number of Shares	Book Value	Market Value
TOTAL (Forward)		$923,728.89	$1,253,803
Members-for-Life Fund:			
American Telephone & Telegraph, 2¾% debentures, due 1971	$ 5,000	$ 4,775.00	$ 4,338
Consolidated Edison, preferred stock	90	9,925.78	9,326
U. S. Treasury bonds 2½%, due December 15, 1972-67	$ 5,000	4,973.44	4,478
TOTAL		$ 19,674.22	$ 18,142
International Electrical Congress of St. Louis:			
Library Fund:			
American Telephone & Telegraph, 2¾% debentures, due 1975	$ 5,000	$ 5,031.25	$ 4,162
Edison Medal Fund:			
General Electric, common stock	450	$ 9,131.25	$ 28,519
Edison Endowment Fund:			
United States Treasury Bonds 2½%, due June 15, 1967	$ 7,700	$ 7,827.45	$ 7,069
Lamme Medal Fund:			
E. I. du Pont de Nemours $4.50 preferred stock	50	$ 5,952.00	$ 5,225
General Motors, $5 preferred stock	24	2,980.44	2,676
TOTAL		$ 8,932.44	$ 7,901
Volta Memorial Fund:			
United State Treasury bonds 2¼%, due December 15, 1962-59	$13,000	$ 13,390.00	$ 12,196
TOTAL		$987,715.50	$1,331,792

HASKINS & SELLS
CERTIFIED PUBLIC ACCOUNTANTS

67 BROAD STREET
NEW YORK 4

May 28, 1957.

ACCOUNTANTS' CERTIFICATE

American Institute of Electrical Engineers:

We have examined the balance sheet of the American Institute of Electrical Engineers, and schedule of securities owned, as of April 30, 1957, and the related statements of income and operating fund reserve and of restricted fund reserves for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the accompanying balance sheet, schedule of securities owned, and statements of income and operating fund reserve and of restricted fund reserves present fairly the financial position of the Institute at April 30, 1957, and the results of its operations for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

(*Signed*) HASKINS & SELLS

OF CURRENT INTEREST

U. S. S. Arneb (*AKA-56) unloads supplies at Little America V. Empty sleds were positioned by 37-ton low ground pressure* D8*'s, then retrieved by cable to lessen the danger of breaking through the ice.*

Official U. S. Navy Photograph

Operation Deep Freeze

Under Way in Antarctica for the IGY

LIGHTED only by glittering stars and an occasional, spectacular Aurora Australis, seven small Antarctic outposts have battened down the hatches for a long, cold winter's night. The sun has set below the northern horizon, not to reappear again until October. With it went the 12 ships, 40 aircraft, and more than 3,500 U.S. Navy, Coast Guard, Air Force, Army, and Marine Corps personnel that had bustled around and across this desolate, ice- and snow-covered wasteland.

Only 169 Navy men and 148 scientists remain behind, scattered at five stations around the continent and at two stations inland, one 10,000 feet high at the geographic South Pole, the other high on the Rockefeller Plateau.

An almost impossible schedule has been challenged and conquered, and the United States is ready for its scientists to carry out their assignments of observation and investigation during the 1957-58 International Geophysical Year (IGY).

More than 500 tons of cargo had to be moved the 660 miles on 20-ton sleds pulled by Caterpillar low ground pressure *D8* tractors, 72,000 pound machines with extra-long, extra-wide tracks.

Late last season, a team of "weasels," personnel carriers, and *D8's* moved out to mark a trail and establish a fuel cache at the 360-mile mark in preparation for the coming year. But 200 miles from Little America V they encountered a heavily crevassed section.

Unable to go around the crevasse belt, the Seabees started across, gingerly feeling their way along. When a crevasse was located, it was blasted open with explosives and filled with snow dozed in by the *D8's*.

This year the men came back with a newly designed crevasse detector, developed in the Arctic *Electrical Engineering,* July 1957, page 648). Mounted on a weasel, a light tracked vehicle about the size of a jeep, the detector utilized two dishpan-shaped transmitters towed astern to send 3,000 volts forward into the snow and ice. Five more dishpans on booms slid ahead over the snow, receiving impulses from the transmitters. Voids under the surface, both across and parallel with the trail, were easily detected and bypassed, or blasted open and filled with snow if bypassing was not possible.

Extreme caution had to be exercised in crossing the crevassed area. Only one 37-ton *D8* at a time, pulling one 26-ton sled, would venture up the 7½-mile trail. Then Chief Warrant Officer Victor Young, USN, of Wickford, R.I., in charge of train, would wait for the "nervous" ice to settle before sending another load across. As an extra precaution, operators walked behind their tractors, guiding these behemoths by reins attached to steering and master clutch levers. If the tractor should break through, the men would have a chance to get clear.

When the train safely reached Byrd Station, the men found 30 tons of fuel, accurately dropped at the site by Navy and Air Force planes, waiting for their use on the return trip to Little America V.

Meanwhile, the other members of Navy Task Force 43, under the command of Rear Admiral G. J. Dufek, had weathered the darkest hour of Operation Deep Freeze. Rising temperatures and dwindling fuel supplies forced the 18th Air Force to withdraw its *C-124* Globemasters from the McMurdo Sound air base to New Zealand. A New Year's Day storm with hurricane intensity drove accumulated ice against the *U.S.S. Arneb* (AKA-56), then unloading supplies for the Cape Hallett Station, 400 miles north of McMurdo Sound. Ice had packed in this area to the extent of 200 square miles. Pressure ridges in the ice sprung bulkheads and slit the hull below the water line, flooding several compartments. The ice-breaker *U.S.S. Northwind* (WAGB-282), struggling to the aid of the *Arneb,* lost a blade from her starboard screw.

On the opposite side of the Antarctic Continent, trying to reach Bowman Peninsula to establish the Weddell Station, an icebreaker and a cargo ship were stuck in the treacherous ice, 370 miles short of their goal. The icebreaker *U.S.S. Staten Island* had lost a blade from one of her screws and had used up more than half her fuel unsuccessfully battling the ice; the *U.S.S. Wyandot* (AKA-92) had worn off the tips of all her screw blades on the crushing ice, reducing her speed to 10 knots. In previous years, three ships had been crushed by the ice in the these waters.

But lowering temperatures and a team made up of *D8* tractors, working around the clock, readied the air strip for the return of the Globemasters. The *U.S.S. Nespelen* (AOG-55) arrived with 540,000 gallons of aviation gas. Friendly winds from the south drove the ice to sea, freeing the *Arneb* and the *Northwind*. The *Arneb* was heeled over, exposing the ruptured hull for repairs. And favorable winds and rising temperatures opened a passage to the Bowman Peninsula for the *Staten Island* and the *Wyandot*.

Rear Admiral Dufek landed at the South Pole on October 29, 1956, the first man to set foot there since the ill-fated Scott expedition 44 years previously. Three weeks later, two other Navy *R4D*'s set up the first colony at the Pole, comprising 8 men, 11 dogs, and a few tents.

Then the 18th Air Force moved in from New Zealand with eight *C-124* Globemasters for the 1,500-mile round trip from McMurdo Sound. Under the command of Col. Horace Crosswell, the Globemasters began parachuting the needed 500 tons of supplies around the clock, weather permitting.

On the ground, with a force swelled to 24 men, Lt. R. A. Bowers, Quonset Point, R. I., directed construction of the Pole Station to accommodate 18 men over the coming winter. With temperatures ranging from 25 to 35 degrees below zero and in the rarefied air of 10,000 feet altitude, men and machines could work at only 60% efficiency. The wintering-over party was flown in—11 scientists under the direction of Dr. Paul Siple and 7 Seabees under Lt. (jg) John Tuck, of Auburn, Miss.

Another record-setter of the South Pole operation was Air Force Sgt. R. J. Patton, St. Louis, Mo. When air drops were stalled because parachutes failed to open or became disengaged, burying supplies up to 15 feet deep in ice and snow, Patton volunteered to jump to the station in an effort to find out what was wrong. Made in bad weather which prevented smaller aircraft, capable of landing on the snow, from climbing over the mountains, the jump by Sgt. Patton was the first and only such feat in Antarctic history.

Official U. S. Navy Photograph

CREVASSES hidden by layers of snow were easily located with this electronic crevasse detector. Two trailing disks transmitted 3,000 volts into the snow while five forward disks (arrows) picked up radiation and warned of voids under the surface.

The air strip from which the Navy and Air force planes worked had been wrested by the Seabees from the snow in two cold, dark months. They were forced to clear the snow from the ice, but only one tractor, a standard *D8*, was available to clear the 8 to 14 feet of snow from the proposed air strip, 300 feet wide by 6,200 feet long.

Planes were scheduled to start the fly-in from New Zealand October 13, so the Seabees climbed aboard "Pogo," as they had named their only hope, and began around-the-clock snow clearing with portable generators lighting the scene. Temperatures ran to 60 degrees below zero, and men had to be replaced every 45 minutes.

As Commander H. W. Whitney, commanding officer of the wintering-over party, said: "Parts seemed to have greater metal fatigue in the extreme cold, and the work was very rough. We ran out of replacement parts and finally had to rebuild certain parts so we could continue."

Sometime later, the *Arneb* and the *Northwind* headed for McMurdo Sound where they were joined by the world's largest ice breaker, the *U.S.S. Glacier* (AGB-4), and the cargo ship *U.S.N.S. Greenville Victory* to assault the Budd Coast where Ellsworth Station was to be established. Again the pack ice was extremely heavy, and the *Glacier* crunched through to three dead ends before the fourth try made the breakthrough for cutting the 125-mile belt of ice.

A 15-foot ice shelf still stood in the way of landing operations. First men went ashore, and with picks, shovels, and 12 tons of explosives ripped a path through the shelf. Then a Caterpillar *955* Traxcavator was brought in on a landing barge to shave a gentle ramp for the heavier tractors. Two weeks later the camp was completed—16 buildings, a forest of radio masts, and odd shaped domes and towers. Construction had been expected to take at least seven weeks. Ice and snow, wind and cold, all had combined to repel the invaders. But the "can do" men of Operation Deep Freeze beat both the elements and the schedule.

As the sun circled lower, the ships, planes, and most of the men withdrew. Only the emergency station on Beardmore Glacier, built for support of aircraft on flights to the South Pole, had been abandoned.

As the darkness now embraces the land, another Antarctic miracle has taken place. Electric lights shine, turning each camp into a glistening city under the snow. Electricity for lights, for communications, for freezers and stoves, for the thousands of instruments needed by the scientists and for the comforts of home—all are provided by Cat *D315* and *D342* electric sets, using the same type engines as in all the tractors and Traxcavators in the Antarctic for standardization of parts.

Three 100-kw *D342* sets supply the needs at McMurdo Sound; five 30-kw *D315* sets are used at Little America V. Nearly 20,000 feet of wire was needed for the 36 buildings at McMurdo. And good grounds are impossible, particularly through the 800 feet of ice the Little America V Station sits on. In all, 34 Caterpillar-built electric sets were taken to supply the needs of these seven camps.

In addition to supplying electricity, the engines are used for snow melting and heating. Exhaust gases pass through snow melters, producing water for cooking, drinking, and washing. In some instances, the electric sets are placed adjacent to the heads, and a fan blows engine heat down box tunnels to keep the water pipes from freezing. Water for the galleys and other heads is supplied by hot water boilers.

Now the scientists have taken over to study the aurora, cosmic rays, geomagnetism, glaciology, ionospheric physics, meterology, rocket exploration of the atmosphere, seismology, and gravity. These findings will be incorporated with those of the other hundred stations the United States has from pole to pole and from the stations around the world of the other 41 nations co-operating in the 1957-58 IGY.

Results already have been realized with the magnetic south pole believed now to be located 600 miles east of its presently charted position. This knowledge will permit more accurate correction of magnetic compasses. Weather information is being gathered to help more accurately predicted weather around the world. And other results will soon follow.

Roadway Lighting Facility Is Unveiled

A DEMONSTRATION roadway lighting facility where more than 30 different lighting combinations can be observed has been unveiled at General Electric's (GE) Outdoor Lighting Department, which is stated to be "the Outdoor Lighting Center of the World."

Although the demonstration streets measure less than one third of a mile in total length, they offer opportunities for demonstrating the effects of virtually every combination of modern lighting that can currently be applied to America's roadways. An individual would necessarily visit 25 to 30 different towns to see everything that can be seen at one time and in one spot at Hendersonville. As far as is known, this is the only facility of its type anywhere in the world. The demonstration streets are a part of GE's $500 million program of expansion and modernization for the years 1956 through 1958.

The area is designed to provide practical demonstrations of all types of street lighting equipment on different types of pavement and on all major street classifications. Here users of street lighting equipment—municipal officials, state highway representatives, electric utility lighting engineers, and others—can compare and evaluate different light sources for a variety of applications.

GE News Bureau Photo

PROVING GROUND, capable of simulating roadway lighting conditions anywhere in the world, has been unveiled at Hendersonville, N. C. Photo shows the one-third mile road network showered by light from more than 130 street lighting fixtures of 15 different types.

This facility will be used by GE to conduct extensive studies, investigations, and research on how well the night driver actually sees under various roadway lighting systems.

A master control panel enables an operator to make rapid changes of lighting setups so viewers may compare effects of all three major light sources—filament, mercury, and fluorescent—on streets similar to those found in any community. Comparisons can be made of effects created by the newest, most modern luminaires as well as older lighting fixtures still in use on many American streets.

Provision has been made for testing the effect of all three major light sources on residential streets, traffic streets, main business streets, and whiteways varying in width from 25 to 70 feet. Different types of units are mounted on steel, aluminum, concrete, and wood poles with a variety of brackets. Both overhead and underground wiring is used, and multiple and series circuit equipment is demonstrated.

Included in the demonstration area is a 100-foot stretch of parallel-to-roadway fluorescent street lighting—an experimental new system of roadway illumination under development by the Outdoor Lighting Department. In addition, there is a demonstration of "T-lighting" which is an offshoot of parallel lighting. Engineers at GE have mounted two form *206S* luminaires end-to-end and parallel to the curb at the base of a normally mounted form *406S* unit to form the "T-lighting" configuration.

Electrons "Kiss and Tell"

Electrons are revealing the answers to problems that have been plaguing manufacturers for years, thanks to the Electron Diffraction Instrument (EDI), according to the General (GE) X-Ray Department, Milwaukee, Wis.

"Why did the paint peel off the automobile?"

"Why did the gas pipe rust through?"

The answer to these and many other questions are being studied by users of the unit, which "bounces" a stream of electrons off the surface of various materials and produces a characteristic pattern that can be used to guide the development of better manufacturing processes and materials.

It is also expected to prove useful in such fields as lubricating films, metalplating, powder metallurgy, boiler scale formation, and catalyst behavior.

The EDI is similar to X-ray diffraction apparatus. The basic difference is that electrons penetrate much less than X rays, As a result, the chemical composition and crystal structure of a substance's surface can be determined. On the other hand, a beam of X rays from a sample provides information relative to the average of the entire sample.

Electrons can detect samples as thin as 15 angstrom units (0.000004 inch), permitting electron beam transmission through very thin surfaces. Diffraction patterns so produced usually require exposures of only one second to two minutes.

The specimen is positioned by means of a manipulator. The resultant diffraction pattern can be observed on the fluorescent screen and photographed with the camera mechanism. Five exposures can be made at one loading of the camera.

A high temperature furnace for studying changes in specimens at variable high temperatures up to 1,000 C is available as an auxiliary device for the EDI.

About the size of a conventional cigaret lighter, the unit incorporates a cylindrical ceramic body into which is embedded a heater coil and a thermocouple. The specimen tray and several other components are made of tantalum to utilize this metal's good conductivity and high melting point.

Because electron diffraction "completes the picture," it is expected that this technique will receive the wide application to

Future Meetings of Other Societies

International Geophysical Year, 10 major physical field co-ordinated investigations, July 1, 1957 through December 1958, U. S. National Committee, IGY, National Academy of Sciences, Washington 25, D. C.

Nuclear Energy for Industry

Nuclear Engineering Short Course, July 1-August 30, Engineering & Sciences Extension, University of California, Berkeley 4, Calif.

AMA, summer education program, July 8-August 30, Colgate University, Hamilton, N. Y.

Institute of Aeronautical Sciences, National Naval Aviation Meeting, August 5-10, U. S. Grant Hotel, San Diego, Calif.

ASME, 1st National Conference, Heat Transfer Division, August 12-15, Pennsylvania State University, University Park, Pa.

International Scientific Radio Union, 12th General Assembly, August 18-31, Boulder Laboratories, National Bureau of Standards, Boulder, Colo.

High Energy Physics Symposium, sponsored by Oak Ridge National Laboratory and Oak Ridge Institute of Nuclear Studies, August 19-24, Oak Ridge, Tenn.

Management Science and Computer Technology Courses, August 19-30, University of Michigan College of Engineering, Ann Arbor, Mich.

Liquid Scintillation Counting. August 20-22, Technological Institute, Northwestern University, Evanston, Ill.

Western Electronic Show and Convention, August 20-23, Cow Palace, San Francisco, Calif.

International Radio Scientific Union, 12th General Assembly, August 23-September 3, Boulder, Colo.

7th International Combustion Symposium, August 28-September 3, The Royal Institution and Oxford University, London, England.

ASME, Heat Transfer Conference, August 11-15, Pennsylvania State University, University Park, Pa.

Computers and Data Processing, 4th Annual Symposium, August 29-30, Albany Hotel, Denver, Colo.

Engineering, Marine, Welding, and Nuclear Energy Exhibition, August 29-September 12, Olympia Hall, London, England

Peaceful Atomic Energy Uses, 2nd U. N. Scientific Conference, September 1-13, Geneva, Switzerland

IUGG, 11th General Assembly, September 3-14, University of Toronto Campus, Toronto, Ont., Canada

American Mining Congress, Metal Mining and Industrial Minerals Convention, September 9-12, Hotels Utah and Newhouse, Salt Lake City, Utah

3rd Annual Titanium Lecture, September 9-13, College of Engineering, New York University, New York, N. Y.

industrial problems now realized by X-ray diffraction. The advantages can be summarized as follows: (1) Electrons can be diffracted by shorter atomic crystal plane spacings. This is because, for practical accelerating voltages, electron wavelengths are about 1/20 that of X-ray diffraction. As a result, crystal size estimates for a smaller size range can be determined. (2) The electron beam is much easier to collimate and reduce in size than the X-ray beam. And (3) sharper patterns are possible because the electron beam is highly monochromatic. And patterns can be seen visually on a fluorescent screen. Therefore, it is not necessary to photograph the pattern for some types of routine control work.

Starting with the electron gun, the filament operates at a fixed potential, variable from 20 to 50 kv and negative with respect to ground. To obtain a more constant temperature, the filament is heated with separate radio frequency source.

The resulting electrons are accelerated through a grounded apertured anode and focused on a fluorescent screen in the camera chamber by means of an electromagnetic focusing coil.

An instrument capable of chemically analyzing as minute an amount of material as five micromicrograms will naturally lend itself to many research and production applications.

Recordings Brief Pilots of Foreign Flag Carriers

An idea that started as a "gimmick" by air traffic controllers at Miami International Airport to make their jobs easier and to promote air safety in the area, shows promise of turning into a large-scale regular program by the Civil Aeronautics Administration of the U. S. Department of Commerce.

It all came about as a result of heavy increases in traffic into the Miami area from Central and South American countries, which resulted in some misunderstandings between controllers and pilots because of language differences. So someone had the idea to indoctrinate pilots of foreign flag air carriers in air traffic control procedures and traffic clearances.

Control tower personnel prepared tape recordings of typical clearances into and out of the Miami area which were tailored to the name and aircraft identification of the individual air lines.

The tapes were made to contain general information about the air traffic control in the Miami area, radio frequencies for ground, local approach and departure control, and examples of traffic clearances in each case. The tapes were taken to their home countries by pilots for training purposes.

To date, 40 pilots have taken advantage of the program including fliers from Guatemala, Chile, Colombia, Brazil, Argentina, Peru, Venezuela, Mexico, Panama and Cuba.

Plans are under way to expand the program to Chicago and possibly to New York to assist pilots who will begin flying into those areas as a result of extension of foreign airline routes.

Tactical Support Center To Aid in Nuclear-Age Combat

A new vehicle-mounted U. S. Army communications system has been developed which will give commanders in nuclear-age combat instant control over dispersed tactical support elements, the department of the Army announced recently.

Called the Tactical Support Center (TSC), the system allows a field army commander to weld his highly mobile support forces into a co-ordinated, power-packed team.

Two TSCs designed and built by the U. S. Army Signal Engineering Laboratories, Fort Monmouth, N. J., were tested recently under field conditions by the 18th Airborne Corps in the King Kole Maneuvers at Fort Polk, La.

The need for these TSCs grew out of the complex nature and rapid movement of modern warfare. Problems of liaison between such tactical support elements as artillery, electronic warfare, tactical air support and antiaircraft are becoming much more complicated than was the case during World War II or even during the Korean fighting.

The TSC is housed in 13 vans and trucks, and tents carried in the vans. Specially designed cable plugs are built onto each of the vans for rapid interconnection. The TSC is organized into five major organizational sections: the control center, which is the heart of the operation and headquarters for the TSC director; the direct support aviation section; the electronic warfare section; the fire support, or artillery, section; and the air defense section.

The TSC concept provides for use of nearly every available communications medium, including radio, teletypewriter, telephone, television and facsimile, and has its own power generators. Flexibility of communications both within the TSC and between it, headquarters, and support elements is thus insured. The TSC also contains darkrooms for reproducing maps and photographs. In keeping with the mobility of modern armies, the TSC itself is capable of rapid movement and instant operation.

Powerful Radio Transmitter To Be Installed for Pentagon Use

A powerful new short wave transmitter which can beam vital defense messages to any spot on earth, even through severe interference, has been developed and will be installed for Pentagon use, the Department of the Army announced recently.

Called the "World Spanner," the transmitter was designed for use as part of the U. S. Army's world-wide communication network by the U. S. Army Signal Engineering Laboratories, Fort Monmouth, N. J., and by Continental Electronics, Inc., of Dallas, Texas. The big set is almost 50 times more effective than the loudest commercial broadcasting station.

The set owes its tremendous power to single sideband design, an electronic technique which concentrates the power of a transmitter's signal. Conventional transmitters broadcast three separate signals—a carrier wave and two duplicate sidebands. Single-sideband circuits filter out the carrier wave and one sideband, thus funneling all of the power into the remaining sideband. This provides eight times the strength of conventional transmitters with the same power supply, it was stated.

With ordinary design, the World Spanner would have a power of 300,000 watts. With the new single-sideband refinements and a new beam antenna now under development, effective power will reach 24 million watts.

Although changing channels on a high-power station usually is a major job, the World Spanner will be almost as easy to tune as a push-button radio. An operator easily can go on the air at any one of 10 previously set frequencies by turning a single switch. The transmitter easily sends 64 teletypewriter messages or four separate voices at the same time.

Despite this immense power, the new transmitter is completely safe to operate. Multiple safeguards make shocks impossible. Before its high voltage can be applied, access doors must be closed and all keys inserted into a master safety panel.

A total of 18,000 volts applied to a 150-pound vacuum tube, built by the Radio Corporation of America, when it is on the air.

Compact design makes the World Spanner smaller than transmitters with far less power and with all accessories it can be housed in a 50-foot square room. Maintenance is simplified despite this compactness. One man can replace the 150 pound tube in little more time than he would need for its smaller counterpart in an ordinary radio.

World Spanner can transmit at any frequency in the short wave spectrum from 4 to 30 mc, and a second version will cover the range from 20 to 65 mc.

"Talk Down" Psychological Device

One of the objectives of psychological warfare is talking enemy troops into surrendering. A means of "talking" to ground forces from high altitudes has been devised under the supervision of the Air Research and Development Command (ARDC).

The verbal peace appeals can be parachuted to earth from high altitudes. After descending to 4,000 feet, the magnetic tape playback drives an amplifier producing a volume 250 times louder than that of the average home television set.

Nicknamed "Talk Down," the set fills a requirement for a means of "talking" to ground troops when weather conditions and ground fire prohibit the use of airborne verbal appeals delivered from low-flying aircraft.

The device is officially designated as Sound Producer Set *AN/ANH-4* and operates in the following manner. A barometric switch opens a 6½-foot ribbon type brake chute at about 12,000 feet, slowing the bomb-shaped device to a safe speed for the main parachute. When the barometric switch is activated, a timer starts functioning and at 6,500 feet, the tail separates from the main body, pulling out the 66-foot main parachute. At 5,000 feet, "Talk Down" becomes stabilized and the nose separates from the main body, exposing the speaker.

The set then operates for five minutes during descent from 4,000 feet down to ground

Development of "Talk Down" is the result of interservice and industry co-operation. Project monitor was ARDC's Wright Air Development Center, Wright-Patterson Air Force Base, Ohio, while the development contract was let to the Cook Research Laboratories, Skokie, Illinois.

Preliminary air-to-ground acoustic measurements were made by a U. S. Navy blimp at Lakehurst Naval Air Station, N. J. External container and parachute tests were conducted at the 6511th Test Group (Parachute), El Centro Navy Auxiliary Station, Calif., a joint Air Force-Navy organization.

Final over-all evaluation tests were conducted at Fort Bragg, N. C., in co-operation with the Psychological Warfare Board, an Army installation and organization.

Electronics in the Medical Field

In the past 10 years, industrial and military demands have spawned an infinite variety of important new developments in instrumentation (the technique of automatic measurement, computation, and control). Very few of these new techniques have filtered out to the nonmilitary and nonindustrial fields. A semantic as well as technical curtain has thwarted cross-fertilization. Specialists in either discipline have lacked the time and motivation to penetrate this curtain.

One of the most neglected—and potentially most exciting—areas for new instrumentation is the field of biology and medicine. Few physicians have the technical knowledge needed to develop new instruments. Conversely, most professional instrument designers have little background in biological fundamentals.

A unique experiment in technical cross-fertilization offers a powerful way to crack this barrier between fields. Called a "Conceptual Clinic" by its cosponsors (the Foundation for Instrumentation Education & Research, and the New England Institute for Medical Research), the experiment brought together two dozen of the country's top professional instrument designers and a group of highly qualified biological-medical researchers. Cloistered for two days at the Institute's laboratory in Ridgefield, Conn., the scientists, doctors, and engineers explored the potential of new instrument techniques for measuring and diagnosing physical and chemical variables in the human being.

A medical milestone was marked with the introduction, at St. Luke's Hospital in Chicago, Ill., of a new approach to classroom instruction—a "surgeon's eye" technique that brings medical students in unlimited numbers virtually as close to an incision as the doctor's own elbow.

Manufactured by Dage Television, Division Thompson Products, Incorporated, Michigan City, Ind., full-color, closed-circuit television is the electronic magic that makes this possible, transmitting to students many floors away the life-and-death immediacy of the surgical routine. The doctor's commentary, simultaneously transmitted, informs them as well of the special problems attendant upon each individual case.

The drama of the operating room, once available to students only through textbook descriptions as static as a play in print, or from remote tiers in an amphitheater as divorced from detail as a second balcony seat, now becomes as intimate as theater-in-the-round, imbuing viewers with a sense of actual participation.

The "surgeon's eye" technique is now available to modern hospitals through new developments in a branch of electronics closely allied with medical science in pushing back the barriers of pain and death. This is the 3-vidicon electronic television system.

Two cameras are utilized in the system installed at St. Luke's, one of which receives its impressions from films or slides. The more dramatic of the two is the "surgeon's eye," carried by special suspension equipment known technically as a "surgical camera positioner mechanism."

This camera literally peers over the surgeon's shoulder, following the operative procedure with the unobtrusive alacrity of a well-trained nurse. The camera, which can be rotated as well as moved in three directions, is manipulated by remote control. The operator, the only technician required for "surgeon's eye" telecasting, remains completely out of the way in a special observation booth at the rear of the amphitheater.

Electronic science joins hands with medical technology in a dramatic new heart catheterization technique developed at the Cleveland (Ohio) Clinic, where surgical time for this delicate operation has been reduced by 20 to 30%.

Utilizing a standard fluoroscopic image amplifier in conjunction with a special closed circuit television system, Cleveland doctors have succeeded in eliminating much of the strain and tension once attendant upon probing the living human heart.

Secret of this alleviation is television, with emphasis upon vision. Formerly, the surgeon worked of necessity in a darkened room, crouched awkwardly for hours over the tiny 1½-inch periscopic image of the patient's heart that guides his caution-fettered hands. Now, thanks to combined electronic X-ray techniques, he can work in a normal position in a well-lighted room with a sure touch derived from watching his own operative progress in a life-sized image of the patient's heart.

This picture is transmitted by a Dage television camera, mounted well out of the way above the operating area, from the small light-intensified fluoroscopic image to a large-screen monitor placed across the table from the surgeon.

Benefits of this system are manifold. Simultaneous viewing of the heart by both the doctor and his assistant speeds diagnosis as well as permits the instruction in the intricacies of heart catheterization to medical students with new graphic impact through classroom viewers, thus preparing the coming generation of doctors for execution of this difficult operation with utmost efficiency and dispatch.

The development of a color X-ray viewer system that increases the readability of X-ray pictures through the use of contrast enhancement and color television techniques, has been announced by Philco Corporation.

The "Exicon" X-ray viewer system performs three essentially different, but equally important, functions to extract quickly and accurately a maximum amount of information from an X-ray transparency, according to the chief of radiology of the Einstein Medical Center, Northern Division, Philadelphia, Pa. It is said that the system "enhances X-ray contrast in 'gray scale' variations, increases readability by utilizing full color, and magnifies an area being viewed."

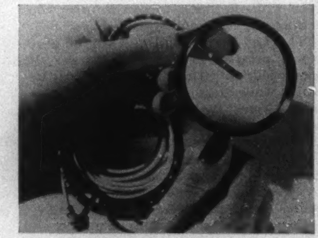
Areas having differential optical density are reproduced in other colors such as blue, cyan, green, yellow, orange and red. Thus, opaque solutions injected into the blood system can be followed in color through the heart and blood vessels of the lungs and other organs, lending more accuracy and realism to the X-ray picture. Tissues not clearly seen heretofore will now be made visible in color. The new system consists of monochrome and color monitors, an operators' console and a flying spot scanner. An X-ray negative placed before the flying spot scanner will be magnified and separately reproduced in enhanced monochrome and color. Negatives may be quickly shifted about to obtain magnified images of any portion. The system may be used in conjunction with closed circuit color television installations.

On the color monitor, the strongest signal obtained from particularly transparent sections of the X-ray negative will be portrayed as the color red; the weakest signal will show up as blue.

A tiny microphone, so small that it can be passed through an artery or vein directly into any part of the heart, promises great help for heart specialists, seeking to diagnose and determine the exact location and extent of heart defects.

The development of the heart microphone and the technique of using it has been a joint project of Gulton Industries, Inc., of Metuchen, N. J., and Mount Sinai Hospital. Dr. Walter Welkowitz, Ph. D., of Gulton Industries has been in charge of the engineering phases of the heart microphone's development. Dr. Moscovitz's Hospital colleagues in developing the techniques of using the microphone include Dr. Ephrain Donoso and Dr. I. J. Gelb.

A microphone of ultrasensitive design, measuring only 0.05 inch in diameter and only 0.75 inch in length, is inserted into the tip of a standard cardiac catheter and con-



HEART MICROPHONE, occupying only three quarters of an inch at tip (magnified portion) of standard heart catheter, can be inserted into any of four chambers of heart for direct sound readings. Developed by Gulton Industries, it is one-twentieth inch in diameter.

nected by cable to an oscilloscope. Passed into the heart through a vein or through an artery, the device can be manipulated by the physician to the exact location he wants to pick up precise sounds of the heart beat and the blood-flow. The heart microphone permits physicians to diagnose sounds of a heart ailment directly from the point of defect, rather than indirectly by stethoscope through the chest wall.

The heart microphone picks up heart sounds directly and eliminates interference of extraneous noises such as breathing, digestive activity in the stomach, and the normal outside sounds in the examination room. Additionally, it assures accurate recording of the heart sounds despite the physician's own hearing defects, and eliminates the natural inaccuracies, inherent in the use of the stethoscope, due to the necessity of the heart sounds traveling first through the lungs and body tissues of the chest walls before reaching the stethoscope and finally the doctor's ears.

Sound energy, picked up by the heart microphone shows a visual pattern of heart sounds on an oscilloscope. Trained physicians can interpret the patterns to determine the exact sounds taking place at the point of location of the microphone within the heart.

A minute diaphragm located in the tip of the catheter is connected to a pressure measuring device to convert blood pressures into electrical energy, which are also shown on the oscilloscope. An electrocardiograph hooked into the circuit shows the physician simultaneous oscilloscopic pictures of the heart sounds, the blood pressures, and the electrical impulses generated by the heart, all of which are of extreme importance in diagnosing the type of heart defect and its exact location.

"Cat Eye" To View Mars

The "Cat Eye" light amplifier of the U. S. Air Force's Air Research and Development Command (ARDC), may provide the means for answering the questions about the "canals" on the planet Mars. It may also provide the answers to other questions that have long concerned astronomers.

This may be accomplished by taking better photographs than previously possible, even with the finest telescopes, using conventional photographic methods.

The Cat Eye which grew out of a research program of the ARDC under the sponsorship of ARDC's Aeronautical Research Laboratory at Wright Air Development Center (WADC), Dayton, Ohio, can see a scene at night and reproduce it with daylight brightness, even when the human eye can see nothing. Research work on Cat Eye transducers was conducted for ARDC by Westinghouse Corporation and the Radio Corporation of America (RCA).

Conventional photographs of planets and other heavenly bodies taken even with the best telescopes suffer from the "jitters." The jitter is caused by tremors of air masses in the earth's atmosphere which affect the resolution of distant objects such as planets and galaxies, because the light is deflected first in one direction and then in another. An example is the shimmering of starlight seen on a clear night. This shimmer causes the photographs to blur, because conventional photographic techniques require exposures of several seconds for Mars, and even longer periods for more distant planets or the stars.

By using Cat Eye with a telescope of only 24-inch diameter, it is expected that pictures of Mars may be made in a few thousandths of a second thereby shooting "between" the tremors in the atmosphere.

Photographic exposure times can be reduced 16,000 times with Cat Eye, according to R. K. H. Gebel, of the WADC Aeronautical Research Laboratory. This will permit photographs that might reveal the nature of the "canals" and other features of Mars, and also make it possible to see perhaps 100 times farther into space than with the finest telescope using conventional photography. A transducer produced by RCA is especially suitable for this long distance photography.

Atomic Radiations Control Titanium Furnace

Atomic radiations, in the form of highly energetic gamma rays from radioactive cobalt, have been put to a new and important use by scientists of the Westinghouse Research Laboratories.

The gamma rays are being employed to detect and control the level of molten titanium in a new "cold hearth" arc furnace designed to prepare the purified titanium metal. The titanium furnace on which the control has been placed is a major installation at the Westinghouse metals development plant at Blairsville, Pa.

To carry out their new assignment, the penetrating gamma rays pass through as much as 15 inches of solid metal.

The source of gamma rays, a small needle of cobalt-60, is placed outside the furnace and in line with the top surface of the ingot. The "hot" cobalt-60 is kept inside a shielded lead "box" having walls about four inches thick. When a door in the "box" is opened, a beam of gamma rays passes through the furnace walls and across the top surface of the ingot.

Westinghouse Photo

MODEL of "atomic watchman" which controls level of white-hot titanium inside real furnace is demonstrated by research scientist Paul Malmberg.

If the ingot inside the furnace is too high, it partly blocks the beam of gamma rays, reducing the amount of radiation getting through the furnace. If the ingot is too low, the beam is interrupted less by the ingot, and the amount of radiation through the furnace is greater. These changes in the amount of gamma radiation are used to detect the ingot's position and bring it to its correct level.

The gamma rays passing through the furnace are detected by means of two "scintillation counters." Such a counter contains a crystal which changes the gamma rays into flashes of light. The counter then converts the light flashes into electrical pulses and amplifies them. These amplified pulses are fed to electronic circuits which are designed to drive a hydraulic system that raises or lowers the titanium ingot to the exact position required for proper operation of the arc furnace.

The whole system is so precise that it can detect and maintain the level of the titanium ingot to within one one-hundredth of an inch of its ideal operating position. If, for any reason, the ingot moves beyond its prescribed limits, the gamma-ray control causes immediate shutdown of the furnace.

Radio Contact with *Mayflower II*

The most powerful commercial marine telegraph station found in the United States maintained constant radio contact with the *Mayflower II* during its six-week voyage from Plymouth, England, to Plymouth, Mass., it was announced by Radio Corporation of America (RCA).

Initial contact was established by the RCA's coastal station WCC at Chatham, Mass., as soon as the replica of the original *Mayflower* left its British docks. The first message was a bon voyage wish from Mayor R. F. Wagner, Jr., of New York, N. Y.

RCA technicians said that although excellent radiotelegraph communication was possible, the small transmitter aboard the *Mayflower II* prevented any voice contact until the ship neared mid-Atlantic. At that point in the voyage, a live voice pickup reporting the vessel's progress was made available for network rebroadcasting in the United States.

The installation of the radio transceiver on the *Mayflower II* replica was the only departure from the original ship's furnishings. In all other respects, the sailing vessel is said to be identical to its 17th Century prototype.

The RCA marine station scheduled to track the tiny, wood-hulled craft was located on the site of the original *Mayflower's* first landfall. Because access to the Chatham beach was blocked by a sand-bar, that vessel turned north to Provincetown at the tip of Cape Cod but, finding no fresh water, finally sailed across Massachusetts Bay to make its historic landing in Plymouth in 1620.

Crystalline Material Harder than Ceramics or Metals

A new group of basic materials called "Pyroceram" (registered trade mark), harder than high carbon steel, lighter than aluminum, and up to nine times stronger than plate glass, has been developed recently by Corning Glass Works, Research and Development Division, Corning, NY. This entire group of new engineering materials can be made with a variety of properties.

Over 400 different Pyroceram compositions have been developed at Corning's research laboratories. The first commercial use of these new materials will be for a guided missile radome.

Claimed to be one of the greatest technological advances in glass research since the discovery of heat-resistant borosilicate glass early in the 20th Century. Pyroceram, by a revolutionary manufacturing process, noncrystalline glass is turned into a hard, nonporous crystalline material.

It can be tailor-made with thermal expansions ranging from slightly negative to high enough to match those of heavy metals. The substance can have electrical insulating properties superior to those of the best commercial dielectric ceramics and can be made either opaque or transparent, the first polycrystalline material ever to exhibit this optical property.

Experimental Pyroceram compositions have flexural strengths as high as 60,000 pounds per square inch. The strength-to-weight ratio of one Pyroceram is identical to that of annealed aluminum, greater than that of titanium and stainless steel and is being developed as the material for missile radomes.

In the announcement of this new material, it was stated that certain types of Pyroceram keep their strength at temperatures as high as 1,300 F. With its high strength-to-weight ratio, lightness, and excellent thermal characteristics, Pyroceram has great potential use as a substitute for aircraft metals.

"Unlike most high-strength, high-temperature crystalline materials," said Dr. W. H. Armistead, company vice-president and director of the Research and Development Division, "Pyroceram has great flexibility in forming. It can be made into large or complex shapes by any of the known glass-forming techniques. It is adaptable to mass production, and can be pressed, drawn, blown, rolled, and centrifugally cast."

Another advantage in formability, Dr. Armistead added, is the fact that certain types of Pyroceram can be formed by investment casting techniques such as those used in metal foundries, enabling it to be fashioned into complex, close tolerance parts.

Missile radome cones of Pyroceram protect the sensitive directional instruments in the nose of the missile from the sudden high temperatures experienced in hypersonic flight. The softening point of this Pyroceram is 2,460 F, which is above the melting point of some stainless steels.

Thermal shock resistance of some of these new crystalline materials is greater than that of dense alumina and equal to that of fused silica. The resistance of one Pyroceram to acid and alkali attack is nearly as good as that of Pyrex brand borosilicate glass.

Corning Glass Works Photo

RADOMES made from Pyroceram, new family of crystalline materials, are taken at white heat from the forming machine and rushed to the annealing oven, shown here. Before final heat treatment, radomes are transparent; they turn into a hard, opaque crystalline material after treatment.

This entire family of new materials, was invented by Dr. S. D. Stookey, manager of Fundamental Chemical Research Department.

The new materials are melted and formed like glass, with each batch containing one or more nucleating agents. Subsequent heat treatments cause the nucleating agents to form billions of submicroscopic crystallites in the Pyroceram. As the heat treatment continues, each crystallite acts as a center of crystal growth.

It is by controlling the chemical composition and growth of these crystals that Pyroceram is made with a variety of properties.

The end product, after heat treatment, is an extremely fine-grained crystalline material, nonporous, impermeable, and harder than most ceramics and many metals.

Additional properties of Pyroceram described by Corning scientists include:

Hardness: It is harder than flint and slightly softer than sapphire. It scratches steel.

Porosity: Gas cannot pass through the material.

Elasticity: It is twice as stretchable as glass and two thirds as stretchable as steel.

Color: White opaque, translucent, yellow clear, and it can be colored as ordinary glass.

Toughness at high temperatures: At red heat a nail can be driven into a plank with Pyroceram.

Highlights Planned for Western Electronic Convention

The technical program for WESCON-1957 will offer 225 papers at 48 sessions during the four days between August 20-23, when the electronics profession and industry will dominate convention life in San Francisco, Calif., and the West.

B. M. Oliver, convention vice-chairman for the Western Electronic Show and Convention (WESCON), and D. A. Watkins, chairman of the Technical Program Committee, jointly announced the selection of papers that will make up sessions meeting concurrently in the huge main pavilion of San Francisco's Cow Palace.

Mr. Oliver said program-building has involved four months of conferences and contacts throughout national professional circles by a 34-man committee principally composed of Institute of Radio Engineers (IRE) members in the San Francisco bay area.

WESCON's technical programs have traditionally been the responsibility of the San Francisco and Los Angeles Sections of the Seventh Region, IRE, cosponsor with the West Coast Electronic Manufacturers Association of WESCON.

Mr. Watkins, who is with Stanford University's Electronics Laboratories, has reported that the program selections were made from an unprecedented 552 abstracts submitted.

Working in conjunction with WESCON's arrangements committee, the technical program group is perfecting plans for simultaneous sessions in six separate meeting areas of the spectator-seating banks of the Cow Palace's main arena. Meeting rooms, each holding approximately 400 persons, will be sound-and-sight insulated from other activity by double thicknesses of canvas hangings, treated with compounds to reduce sound penetration.

Except for a special night session on "Controlled Fusion Research" at the Fairmont Hotel, all technical program presentations will be made at the Cow Palace.

Following are the scheduled sessions for the 4 days as well as the starting hour.

- Tuesday, August 20, 9:30 a.m.
  - Transistor Circuits
  - Microwave Components
  - Nonlinear Automatic Control Systems
  - Component Part Design and Performance
  - Electronics Research Abroad
  - Information Theory
- Tuesday, August 20, 2:00 p.m.
  - Models for Systems—Circuit Theory Symposium I
  - Microwave Ferrite Devices
  - Computer Systems
  - Component Part Design, Control, and Assembly
  - Engineering Management
  - Antennas and Propagation
- Wednesday, August 21, 9:30 a.m.
  - Semiconductor Devices
  - Electronics in High Speed Flight
  - Sampled Data Control Systems
  - Communications Systems Engineering
  - Military Research Requirements in Electronics
  - Microwave Antennas
- Wednesday, August 21, 2:00 p.m.
  - Semiconductor Devices
  - Microwave Instrumentation
  - Statistical Methods in Feedback Control
  - Crystal Filters—Symposium
  - Television and Radio Broadcasting
  - Data Handling Devices
- Wednesday, August 21, 8:00 p.m.
  - Controlled Nuclear Fusion
- Thursday, August 22, 9:30 a.m.
  - Computers in Network Synthesis
  - Microwave Tubes—1st Session
  - Computer Circuit and Logical Design
  - Automatic Instrumentation
  - Reliability Program
  - Antennas
- Thursday, August 22, 2:00 p.m.
  - Passive and Active Circuits
  - Microwave Tubes—2nd Session

The Medical Applications of Super-Voltage Radiation
Instrumentation
Vehicular Communications—1st Session
Production Techniques

Friday, August 23, 9:15 a.m.
Audio
Advance in Microwave Solid-State Devices
Analog and Digital Computer Devices
Telemetry—1st Session
Vehicular Communications—2nd Session
New Electronic Techniques for Industry—Symposium

Friday, August 23, 2:00 p.m.
Ultrasonic Engineering
Television Receivers and Televisual Devices
Ionospheric Propagation
Telemetry—2nd Session
Nuclear Science

Safety Is Your Business

Is your portable electric equipment properly grounded? If not, burns and death-causing shock may result, according to the National Safety Council.

Indirect injuries, too, may arise from use of ungrounded portable electric equipment if it is defective. For example, a workman received a slight shock from a defective tool and dropped in on his foot—suffering a painful injury. Slight shocks also have caused fatal falls from heights.

Common portable electric equipment, which often is used in homes as well as industry, includes drills, abrasive tools, and saws. Even equipment that appears to be in safe operating condition may have short circuited, broken, or exposed wires, the Council states. They may make contact with the metal framework of the equipment, causing it to become energized.

To reduce the danger of electrical shock, it is important that a separate ground wire be provided from the tool to a low-resistance ground connection. Water pipes, metal frameworks of buildings, or other metal structures in direct contact with the earth, may be used to ground equipment.

The following are some suggestions on grounding portable electrical equipment:

1. When wiring is enclosed with metal conduit or protected by armored cable, all couplings and fittings used to make connections between the conduit or cable and the electrical equipment should provide metal-to-metal contact to assure a continuous ground return.
2. If the wiring is nonmetallic sheathed cable or knob and tube work—such as is used in construction work—a third wire must be connected to the grounded terminal on the receptacle to provide a good conducting path to a grounding electrode or water pipe.
3. Grounding wires should be checked to see that the size is correct for the capacity of the nearest fuse or other automatic cutout.
4. No fuses, automatic cutouts or hand-operated switches should be inserted in a grounding line.

To ensure automatic use of the ground, a common type of plug with a U-shaped grounding blade and two standard parallel polarized blades now can be used.

The foregoing and additional information is contained in National Safety Council Data Sheet *D-299* "Grounding of Portable Electric Equipment," one of many prepared periodically by safety engineers.

Particles of Matter Exist 6,000 Miles into Space

Using a radio technique they have developed for exploring outer space, Stanford University, Palo Alto, Calif., scientists are unfolding a new picture of the heavens.

In the first "controlled" experiment of its kind, they have provided the most conclusive evidence to date that particles of matter do exist as far as 6,000 miles out in space—that these upper regions are not a great void disturbed only by an occasional meteor.

Earlier concepts of the ionosphere as a 200-mile-thick electrical "shell" of charged particles surrounding the earth are upset by their findings. Instead, the new picture shows the greatest density of particles at the 50-mile-high "floor" of the ionosphere, then a gradual thinning out of particles into space.

Their discovery shatters long-held theories for explaining magnetic storms and auroral displays, and has set scientists looking for new explanations. It also confirms a more recent theory advanced by a Canadian scientist to explain radio's curious "whistler" sounds from outer space.

The Canadian, Dr. L. R. O. Storey, suggested that whistlers are lightning-generated radio signals that penetrate the denser layers of the ionosphere and escape into space. The dense lower layers normally reflect most radio signals, enabling their use for radio communications.

Escaping whistler signals, Dr. Storey surmised, are guided back toward earth by the earth's magnetic field. His idea implied that sufficient quantities of ionized particles exist far beyond what scientists believed to be the limits of the ionosphere, some 250 miles up.

These assumptions are correct, according to the evidence presented by Prof. R. A. Helliwell and his associates at Stanford's Radio Propagation Laboratory. Their report was given at a recent meeting of the International Scientific Radio Union in Washington, D. C.

With support from the Office of Naval Research, the Stanford group carried out the first "controlled" experiment to test Dr. Storey's theory by using a man-made radio signal. In previous "uncontrolled" studies of whistlers there was no way to pinpoint the source of signals generated by lightning. A prearranged signal from the U. S. Navy's transmitter at Annapolis, Md., guided by the earth's magnetic field, was estimated to return to earth after a looping, 20,000-mile trip through space. Sure enough it did—loud and clear—taking about three-fourths second for the journey.

Time delays averaging approximately seven-tenths second enabled Ernst Gehrels, who was at the listening post at Cape Horn, S. A., to distinguish between the regular ionosphere-reflected signals from Annapolis and those guided on the long path through space. Signals arriving via the space route (called the "magnetic-ionic duct" by the experimenters) also were 10- to 30-decibels fainter than the regular signals.

The fact that they received the delayed signal provides irrefutable evidence that particles of matter are present about the ionosphere, Dr. Helliwell stated. In the absence of matter, the earth's magnetic field could not influence radio signals in this region.

Although they have shown the presence of matter above the ionosphere, it was added, they have little knowledge of how it is distributed—whether bunched or spread out evenly through space.

Remote Control for Vehicle Operates Anywhere

A unique system for remote control of vehicles has been introduced recently. Equipped with this system, a vehicle may be used for obtaining data or information from remote, hazardous, or otherwise inaccessible areas via a television transmitter. The system is easily installed in any tracked or wheeled vehicle and uses electromechanical actuators to control the functions usually performed by the driver. The vehicle may be controlled by radio or through an electrical cable which permits a variety of driver locations. Ordinary manual operation of the vehicle is not hampered, and quick switch-over from manual to remote control is easily accomplished.

A push-button starts the engine, and an aircraft-type control-stick steers the vehicle with right-and-left movement at the same time that it controls the throttle with fore-and-aft movement. Moving the control stick all the way to the rear position applies the brake. Other push-buttons on the control box shift the vehicle into any gear selected by the operator.

The rugged system, developed by Lear, Inc., Grand Rapids, Mich., was designed to operate under the most extreme environmental conditions. It has been used in actual testing of U. S. Marine Corps landing vehicles under dangerous surf conditions. In this application, the LVT was controlled by radio from a hovering helicopter or from an observation post on the beach.

Generator for Idaho Hells Canyon

A waterwheel generator stator in three sections has started its journey from the Pittsburgh, Pa., plant of the Westinghouse Electric Corporation to the Hells Canyon section of the Snake River dam project of the Idaho Power Company, which will supply power to a very large area in the northwestern states bordering the river.

The Snake River dam project consists of three dams to be built between Idaho and Oregon, one of which will be located in the area known as Hells Canyon.

The 50-ton section being loaded onto a flatcar at the Westinghouse East Pittsburgh plant is destined for the Idaho Power Company's Brownlee Station at Robinette, Oreg., where it will be coupled with two other identical units to form a complete stator.

When the unit is assembled and tied in, installation of the 100,111-kva generator will be complete. For the three dams that are planned to be built in the Snake River area, the Idaho Power Company has ordered eight of these waterwheel generators from Westinghouse. Four of these units are slated to be installed at the company's Brownlee Station. The other four generators are destined to be installed at the Ox Bow Station of the company.

The Brownlee Station units are rated at 90,100-kw each. Those generators for the Ox Bow Station will have a capacity of 47,500-kw each.

Nuclear Energy Used in Probing Earth for Oil

At a press preview in Pittsburgh, Pa., three new laboratories designed to accelerate the exploration of new frontiers of petroleum science, with a combined multimillion dollar value were opened recently by the Gulf Oil Corporation. These facilities measurably expand the scope of the company's 53-acre Research Center at nearby Harmarville, Pa.

With the assignment of exploring the application of nuclear energy to all phases of the petroleum industry, the new A. W. Mellon Nuclear Science Laboratory has been launched into full-scale operation.

Already begun, it was revealed, are research projects which range from recovering more oil by atomic methods, to possibilities of improving refining by radiation, to creating entirely new products by nuclear energy, to speeding research by "tracer" studies.

This program has been thrown into high gear by the activation of the Laboratory's principal unit, a 3 million volt "atom smasher," known as a Van de Graaff particle accelerator. The machine is the most versatile radiation source of its type in private industry and the most powerful tool for producing beams of electrons, protons, neutrons, and penetrating or "hard" X rays applicable to research.

Adjacent is a shielded radio-chemistry laboratory for handling "hot," i.e., highly radioactive materials. The second level of the building, also underground, and the third floor at ground level, contain laboratories and offices. About 12 scientists work in the building, directing nuclear operations throughout the company's 53-acre Research Center.

Electron bombardment of materials rearranges molecular structure in somewhat the same way as heat does in present refinery processes. The difference is that radiation has the property of raising the temperature of an individual molecule without raising the temperature of the treated material as a whole.

As a result, electron bombardment can effect changes which heat is unable to do because the high temperatures required would destroy the material. Laboratory scientists believe this line of research might possibly lead to nuclear processes which would extract greater value than is now possible from a barrel of crude, and lead to the production of entirely new materials.

Gulf Oil Nuclear Lab Photo

CENTRAL equipment of the new Nuclear Science Laboratory delivers a 3 million volt jolt, and is the most versatile radiation source of its type in private industry. Dr. G. G. Meisels examines the table on which samples to be irradiated will be rotated beneath the nuclear beam.

As an initial step in this direction, the Laboratory has used irradiation to produce from refinery gases, the highest quality gasoline component, hexamethylethane, which has 130 octane rating. Although its cost thus far is prohibitive, the accomplishment illustrates radiation possibilities.

Standards Lab for Testing and Certifying

A new standards laboratory for testing and certifying master mechanical and electrical measuring devices was opened recently by International Telephone and Telegraph Corporation (IT&T), in dedicatory ceremonies which featured an address by Dr. A. V. Astin, director of the National Bureau of Standards in Washington, D. C.

To be known as the IT&T Standards Laboratory, it is located within the IT&T Federal Telephone and Radio Company division's factory building, 100 Kingsland Rd., and within a short distance of Federal Telecommunication Laboratories, IT&T's research division. One of the best equipped privately owned installations of its kind in the world, it is designed to provide a convenient service in the field of mechanical and electrical measurements, supplementing and extending that of the United States National Bureau of Standards, to private companies, to organizations such as universities and scientific foundations, to U. S. Government agencies, and to IT&T System companies throughout the world.

The IT&T Standards Laboratory, according to J. E. Gingrich, its president, is the result of increasing demand by industry for the most accurate mechanical and electrical measurements possible. Modern production methods demand standardization of such work as screw threads, for instance, and where, under Government direction, production of a particular defense item is farmed out to a number of manufacturers, it is vitally necessary that all component parts are made to duplicate standards. With the increase in "off-shore" procurement, the problem is becoming increasingly complicated.

Electrically, the laboratory can provide manufacturers with precise measurements of voltage, current, resistance, frequency, capacitance, and similar basic electrical units. Voltage, capacitance, resistance and other standards used by the IT&T Standards Laboratory are certified by the National Bureau of Standards.

An example of the Laboratory's ability to make precise measurements can be seen in the determination of the dimensions of gauge blocks. These small, highly polished metal blocks are used as "yardsticks" in mechanical measuring and are certified by their manufacturer to accuracies within millionths of an inch. The IT&T Standards Laboratory can measure the length of these gauge blocks directly by means of light rays to an accuracy of better than one-millionth of an inch. This accuracy is attained by use of the latest model of an instrument called a Carl Zeiss, Koester's Absolute Interferometer, the only one of its kind in the United States.

IT&T Standards Lab. Photo

FREQUENCY MEASURING system (left) is checked periodically against transmissions of radio station WWV, which is maintained by NBS, for transmitting standard frequencies on a round-the-clock basis.

The laboratory's electrical equipment permits accurate measurement of radio waves up to 600 million cycles per second, and determination of electrical resistances as great as 5 billion megohms, and as small as one ohm to an accuracy of one part in ten thousand.

Dedication of Plant and Equipment at North Brunswick

At a series of dedication ceremonies, the newly equipped and established plant of the Okonite Company at North Brunswick, N. J., was opened for operation.

The firm had three plants located in Passaic, Paterson, and Wilkes-Barre. Need for less congested quarters, and more equipment was the deciding factor in the acquisition of the new location. The most congested plant was the one in Wilkes-Barre, and so, in order to make for a rounded operation, the equipment and personnel from that plant were moved to the new quarters.

Originally designed for an assembly operation, certain facilities had to be extended in order to handle the needs of heavy industry with processing problems. An industrial gas and compressed air setup, served by two 100-hp Worthington V type air compressors which deliver 465 cubic feet per minute at 125 pounds per square inch, was adequate.

A main substation located 400-feet south of the plant is served by two 26,400-volt circuits (one a stand-by line), which are on the Public Service Electric and Gas Co. system. A transformer and distributor setup converts it to the mezzanine substations within the plant at 13,200 volts. The original transformer equipment was capable of handling 6,000 kva, but it was necessary to install an additional 5,000-kva transformer for the 4,160-volt system to supply the heavy needs of the compounding equipment. The 13.2-kv distribution cables are 3-conductor 350,000 circular mils paper insulated lead covered cables installed in ducts. The 5,000-volt cables are nonshielded Okolite-Okoprene cables. The 600-volt control cables are all Okolite-Okoprene, both single and multiple conductor types.

The main electrical distribution system ducts were laid below the floor level to provide for maximum plant flexibility. Electrical distribution within the plant is handled from five mezzanine area substations equally spaced throughout the length of the plant.

Heating and ventilation are handled from these same areas in the mezzanine with 22 hot air units capable of delivering 2 million BTU an hour. Additional units placed strategically at doorways help maintain even temperatures. Ventilating fans located in the roof take care of air changes.

Conference on Electrical Insulation

The Annual Meeting of the Conference on Electrical Insulation for 1957 will be held again at Pocono Manor Inn, Pocono Manor, Pa., October 21, 22, and 23. Many members will doubtless wish to arrive at the Inn earlier than Monday morning so registration will begin on Sunday afternoon, October 20.

American Plan rates at the Inn will be: $18 per person daily, single room with private bath; $15 per person daily, two people, twin-bedded room with private bath; and $10 per person daily special student rate on a dormitory basis in Manor Lodge. (We earnestly hope this will permit more students to attend our meetings). There will be an added $1.75 daily to all of the foregoing rates to cover gratuities for dining room service, maid service, and bellman service checking in and out of the Inn. This does not cover other miscellaneous bellman service. There is also a 3% State tax which applies to the American Plan. Reservations should be arranged directly with the Pocono Manor Inn. Please state when writing that you will be attending the Conference on Electrical Insulation.

The chairman of the Program Committee for this year's meeting is planning an interesting program. He is E. R. Thomas, Consolidated Edison Company, 4 Irving Place, New York, N. Y., Conference Vice Chairman.

Round table discussions are being planned on subjects of greatest current interest. Suggestions for topics or other items should be sent to Mr. Thomas. Members of the Conference receive the Annual Report of the Conference and the Annual Digest of the Literature on Dielectrics for the combined registration and membership fee of $7.00. Nonmembers attending the meeting may register for a $5.00 fee and do not receive the publications. No registration fee will be required of a bona fide student attending the meeting, but not wishing to receive the publications.

ASTM Announces Officers for 1957-58

The new officers of the American Society for Testing Materials (ASTM) for 1957-58 have been announced as follows:

President—R. T. Kropf, vice-president and director of research, Belding Heminway Company, Inc., New York, N. Y.

Vice-President—F. L. LaQue, vice-president and manager, Development and Research Division, The International Nickel Co., Inc., New York, N. Y.

Directors—C. L. Clark, metallurgical engineer, Timken Roller Bearing Company, Steel and Tube Division, Canton, Ohio; A. E. Juve, director, technical services research, B. F. Goodrich Company, Brecksville, Ohio; J. H. Koenig, director, School of Ceramics, Rutgers University, New Brunswick, N. J.; R. E. Peterson, manager, mechanics department, Westinghouse Electric Corporation, Research Laboratories, Pittsburgh, Pa.; R. W. Seniff, manager research, Baltimore & Ohio Railroad Company, Baltimore, Md.

ASME Secretary Retires after 23 Years

By unanimous vote of the society's council, O. B. Schier, II, has been designated secretary-elect of The American Society of Mechanical Engineers, it was announced by Dr. W. F. Ryan, ASME president. He will succeed C. E. Davies who will retire as secretary after 23 years of service in this office. The post of secretary is the chief administrative office of the society.

Mr. Schier, 49 years of age, has been a member of the ASME since 1932, and a member of the staff in various capacities for the past 11 years. He was elected assistant secretary in 1953 and advanced to the post of deputy secretary in December 1956. He was graduated from Lehigh University in 1929 with an M.E. degree and received his masters from the same institution the following year. He was formerly associated with the Consolidated Edison Company of New York and held the rank of lieutenant in the U. S. Navy during World War II.

Synchrotron Advance in Design Is Announced

The very forces that hold together the universe may now be examined by a synchrotron—atom smasher—of radical new design. Proposed by the Midwestern University Research Association (MURA), this unique machine is being designed in an equally unique manner with the help of an International Business Machines (IBM) digital computer. The effective released energy of this new accelerator will be five times greater than that expected from the largest synchrotron now under construction in the United States at Brookhaven National Laboratories. When finished, the new synchrotron will give the United States a lead over the U.S.S.R., which is now considering a synchrotron twice as large as the Brookhaven one.

MURA, which has its headquarters in Madison, Wis., is a group name for a nonprofit corporation formed by 15 Midwestern universities which have combined funds and personnel to provide the most up-to-date facilities for research and development in the field of high energy physics. MURA has been assisted by the National Science Foundation, the Office of Naval Research, and the U. S. Atomic Energy Commission. Its technical group is under the direction of Dr. D. W. Kerst of the University of Illinois, inventor of the Betatron, another type of accelerator. In its first phase of operation, the work of MURA is centered around the IBM *704* electronic computer. In the study of new techniques in particle acceleration it was found that the ever-increasing amount of computational work could only be handled by such an extremely powerful electronic computer.

The IBM *704* has become the focus for the first phase of this operation. Various design theories are being tested by this machine, thus permitting MURA to arrive at the most efficient design without the construction of many expensive working models and reducing the task of the active experimental and model group under the direction of Prof. Robert Haxby of Purdue University. Doctors L. W. Jones and K. M. Terwilliger from the University of Michigan have already constructed a working model fixed field alternating gradient synchrotron.

The Computer Division, under the direction of Prof. J. N. Snyder of the University of Illinois, not only aids in the design studies, but also hopes to help train young engineers and scientists in the use of this indispensable tool to modern research and science.

Inasmuch as a giant accelerator of this type opens up hitherto untouched areas for study, one can only guess at its possible practical applications. To the nuclear physicists the possible discoveries in the realm of pure science are most exciting. The new synchrotron is such a tremendous leap forward in power that what it will "see" in the atom can only be guessed.

After the fixed field alternating gradient synchrotron is designed and built, data gathered from it can be processed by the computer, which can perform in minutes or a few hours mathematical chores that would require thousands of man-hours. This new design will produce two proton beams of 15 billion electron volts, accelerated in opposite directions. On collision 30 billion electron volts of energy will be available. To release the same amount of energy, a single beam synchrotron would have to be 10 miles in circumference.

The idea of setting up a head-on collision has been known for some time; however, it was not possible to get a sufficient number of protons to make collisions frequently enough. Prof. Keith Symon of the University of Wisconsin, now head of the MURA Theoretical Division; Tihiro Ohkawa of the University of Japan, now working with MURA; and A. A. Kolomenski in the U.S.S.R., each independently suggested the "fixed field alternating gradient accelerator," whose increased intensities made the colliding beam idea feasible. Two such machines, each 500 feet in circumference, would be no larger in size than one single beam machine producing one fifteenth the available energy.

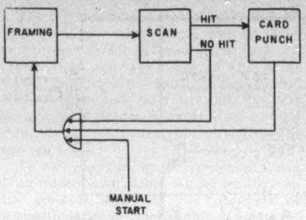
The "elementary" particles, to be studied by this synchrotron, were first discovered in cosmic rays. Protons and other atomic nuclei streaming down at energies of several billion electron volts smashed into other protons and neutrons as they struck the upper atmosphere in what might be characterized as nature's atom smasher. Balloons and rockets with recording devices brought back to earth the faint fragmentary traces of these new strange particles, difficult to identify and classify.

Under laboratory conditions they were first produced in the 3 billion electron volt Cosmotron at Brookhaven and the 6 billion electron volt Bevatron of the University of California. They presented a jumble of data which defied theory and actually led to the rejection of the classic theory of parity, which postulated a symmetrical atomic structure, now considered asymmetrical. It is believed that the "elementary" particles are in some sense manifestations of the forces that bind together the nucleus. The need for high energy accelerators that can produce these particles and produce them in sufficient quantities has become increasingly urgent. There are now approximately 30 of these particles known to exist. Scientists in the U.S.S.R. have discovered several new particles and have passed this information on to Western scientists in a surprisingly free exchange of knowledge.

The interaction of these minute atomic particles is governed by the same basic laws that govern the motions of the planets and stars throughout the universe. What the MURA synchrotron, aided by the IBM *704*, will produce is yet unknown, but what is hoped for is to push closer to a better view of the "elementary" particle and a better understanding of the nature of matter.

Microfilmed Cards Read by FOSDIC II

The National Bureau of Standards (NBS) has completed FOSDIC II—a high speed electronic device that can read microfilmed copies of punched cards and search for cards containing specific information. FOSDIC II (film optical scanning device for input to computers) is an extension of the work which resulted in the original FOSDIC, a device to read microfilmed census documents. Sponsored by the U.S. Weather Bureau, the present machine is designed to aid in the high-speed processing of weather data contained on over 300 million punched cards at the Weather Records Center in Asheville, N. C. It is essentially an electronic scanner which reads filmed images of these punched cards, seeks cards containing special information, and copies this information onto new cards for computer input. The device was developed by M. L. Greenough, and E. C. Palasky of the electronic instrumentation laboratory of NBS to link large files of permanent data on punched cards with automatic data processing equipment.



FLOW DIAGRAM showing general operations of the microfilm punched-card reading Fosdic II.

In maintaining punched card files, the cost of storage and the difficulties of preservation have always been pressing problems. Cards are subject to handling damage and individual loss, and the paper stock itself deteriorates in inactive storage. Moreover, with extremely large quantities of cards, access to the information contained on them is time-consuming. Through the use of microfilms of the punched cards, together with FOSDIC II to recover the data rapidly, (1) file storage space can be reduced by a factor of over 100, (2) the searching logic permits a high degree of selection, (3) duplicate files can be prepared easily and economically, (4) visual inspection of the data content and condition of the storage file is readily apparent with a microfilm viewer, and (5) data can be preserved almost indefinitely. Chiefly for these reasons, microfilm was selected as the new storage medium rather than magnetic tape.

FOSDIC II scans microfilm images of punched cards, searches for specified information, and copies selected item onto new card. Film scanning assembly is contained in racks at right.

The entire image is read out while stationary. The unit reads the film, row by row, in the proper order while maintaining synchronization with the card punching machine. This general method of extracting the information is closely allied to the method of searching. The card is located by the same procedures but in seeking columns, the machine assumes it is interested in all columns. However, it examines only one row at a time in each column. The contents of that row are registered in the memory and FOSDIC II waits until the card punch extracts this information. Immediately after the information is called for, FOSDIC II scans the document again looking only at the next row. This is repeated until all 12 rows have been presented to the punch.

It is expected that FOSDIC II will be followed by similar instruments for reading information contained on microfilm images. There is good evidence that the searching speed of the present device, for instance, can be raised considerably without appreciable loss of reliability. Aside from faster versions, there is the possibility of modifying these scanning techniques to provide an information retrieval machine that searches filmed documents accompanied by coded punched cards. Photographic, rather than electrical, copying of the data might then be employed.

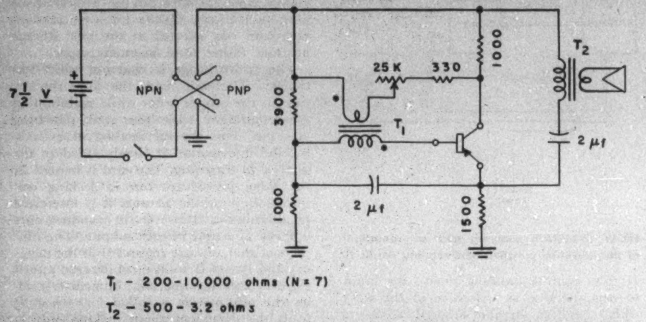
A Simple Transistor Beta Tester

A simple, inexpensive laboratory instrument for measuring the current gain, or β, of a wide variety of transistors has been developed by the National Bureau of Standards (NBS). The testing device, designed by G. F. Montgomery of the electronic instrumentation laboratory of NBS, measures the common-emitter short-circuit current gain of p-n-p or n-p-n transistors at low audio frequency.

In operation, the transistor is plugged into the instrument, and a dial is adjusted to the point where a tone is heard from a loudspeaker. The β is then read directly from the dial. Properly calibrated, the instrument can measure β accurately over a range of 10 to 170.

The circuit is similar in principle to one used for measuring vacuum tube transconductance. In such a tube circuit, part of the plate voltage is fed back into the grid through resistor and transformer coupling to cause oscillation. Similarly, with the circuit for measuring transistor gain, the output is fed back into the input through a variable resistor and a transformer; when the resistor is properly adjusted, the circuit begins to oscillate at an audio frequency. The dial on the variable resistor can be calibrated through a substitution method.

To reduce the number of controls to a minimum, circuit parameters are chosen so that the transistor will adjust itself to a specified d-c operating point. The resistors in the circuit were selected to fix this point at about 5 volts collector potential and 1 milliamperes collector current. For any



CIRCUIT DIAGRAM of transistor β tester. When 25 kilohm potentiometer is properly adjusted for a given transistor, circuit oscillates at an audio frequency and tone can be heard from loudspeaker.

TRANSISTOR β measuring instrument developed at the NBS is inexpensive to build and simple to use for testing the short-circuit current gain of a wide variety of transistors.

transistor whose β falls within the measuring range of the instrument, these d-c values will be closely approximated when the transistor is plugged in.

The frequency at which oscillations begin depends upon the characteristics of the transformer and the phase shift of β. The current ratio of the usual audio transformer has a broad maximum centered at 1 or 2 kc, and if the phase shift of the transistor is sufficiently small, oscillation begins at a frequency near this maximum. However, the transistor gain required to produce oscillation for a given dial setting is not a particularly sensitive function of frequency. Thus, measurements accurate to within a few per cent of full scale can be expected.

Fluid Fuel Reactor Completion Date Extended

L. L. Strauss, chairman of the Atomic Energy Commission (AEC), recently announced a modification to part of the AEC's third invitation to industry for participation in its Power Demonstration Reactor Program which was issued in January 7, 1957. Through this program the AEC provides assistance to industry, both public and private, to use its resources in development of engineering information on performance of nuclear reactors, and to advance the time when nuclear power will become economically competitive.

This modification to the third invitation provides for an extension of the required completion date for full-scale plants utilizing fluid fuel reactor systems from June 30, 1962, to at least June 30, 1963. This extension is necessitated by delays experienced in the AEC's research and development program which is expected to provide basic information necessary to the subsequent construction of full-scale plants of this specific type. As the AEC announced on December 21 1956, there has been a prolonged delay in the startup of the homogenous Reactor Experiment No. 2 at Oak Ridge National Laboratory occasioned by nonnuclear defects consisting of microscopic cracking in the leak detector system and in the flanges in the high pressure system to which the leak detector system is connected. Time had not permitted an evaluation of the full significance of these problems in relationship to the construction of a large-scale aqueous fluid fuel reactor when the AEC issued its invitation on January 7, 1957.

Specific determination of a target date for completion of a large-scale aqueous fluid fuel reactor will be dependent upon further results from the AEC's research and development program. The timing of any AEC request for funds to initiate a Government-financed project involving such a reactor also depends upon the results of the research and development programs.

Not connected with the foregoing announcement, but of interest and in line with Pres. D. D. Eisenhower's atoms-for-peace program, the AEC has authorized publication of its complete file of declassified information through the Readex Microprint Corp., publishers.

In addition to AEC documents, the collection will include the full text of material from non-AEC sources except a small percentage for which copyright permission could not be secured. Researchers now will have 60,000 scientific papers extracts at their fingertips, dating from July 1947 through January 1957.

LETTERS TO THE EDITOR

INSTITUTE members and subscribers are invited to contribute to these columns expressions of opinion dealing with published articles, technical papers, or other subjects of general professional interest. While endeavoring to publish as many letters as possible, Electrical Engineering reserves the right to publish them in whole or in part or to reject them entirely. Statements in letters are expressly undersood to be made by the writers. Publication here in no wise constitutes endorsement or recognition by the AIEE. All letters submitted for publication should be typewritten, double-spaced, not carbon copies. Any illustrations should be submitted in duplicate, one copy and inked drawing without lettering, the other lettered. Captions should be supplied for all illustrations.

Rationalization of Units

To the Editor:

Dr. Silsbee's timely discussion, "Does Rationalization Change Units?" in your April 1957 issue is a clear exposition of the semantic difficulties involved when only four dimensions (such as those of mass, length, time, and current) are used to name electrical units. It is, at the same time, a demonstration of how difficult it is to find a satisfactory terminology to explain the differences between rationalized and unrationalized systems with the use of only four dimensions.

Dr. Silsbee's account, by paying proper attention to the semantics involved, explains how these difficulties have arisen. He points out that, paradoxically, 1 oersted can be $1,000/4\pi$ ampere-turns per meter sometimes, and 1,000 ampere-turns per meter at others.

Similarly, a magnetomotive force of 1 gilbert may be $10/4\pi$ ampere-turns (MKS rationalized units) or it may be 10 ampere-turns (MKS unrationalized units).

An even more interesting example is presented by magnetic flux and magnetic pole strength, which are dimensionally the same, and in electromagnetic units (emu) may therefore both be measured in maxwells. However, 1 maxwell of magnetic flux $= 10^{-8}$ webers (in both MKS systems), whereas 1 maxwell of pole strength may be $4\pi \times 10^{-8}$ webers (MKS rationalized units) or 10^{-8} webers (MKS unrationalized units).

A quantity which has caused much confusion is the intrinsic impedance of free space, which apparently can be both 120π ohms[1] (MKS rationalized units) and 30 ohms[2] (MKS unrationalized units).

Dr. Silsbee's concluding paragraph draws attention to this impossible situation, but does not offer a solution. May I be so bold as to suggest that I can supply one?

In a paper recently published,[3] it was shown that a self-consistent system of equations and units can be developed to take in at least the six most common systems of electrical units (MKS rationalized and unrationalized units, electrostatic units (esu), emu, Gaussian, and Heaviside-Lorentz units). This approach provides both a method and a terminology for converting between equations and units of various systems, rationalized and unrationalized. It supplies unambiguous names for the units of all systems and, thus, avoids the difficulties described. Units named by this system will be called "transitional units" because of the ease with which transitions can be made between different systems.

Transitional units depend on recognizing solid angle S and plane angle U as dimensions, thus making a total of six separate dimensions. Rationalization is then simply the process of changing the unit of solid angle from one steradian to one sphere (4π steradians), as has been explained[3]. Here space permits only the solution to the several apparent paradoxes mentioned earlier.

Instead of mass, length, time, and current, it is generally slightly more convenient to use force F, length L, time T, and charge Q for the four fundamental (or primary) dimensions.

It was shown[3] that the dimensions of the several physical quantities referred to are:

		Dimensions in					
Physical Quantity	*Symbol*	*F*	*L*	*T*	*Q*	*S*	*U*
Magnetic field intensity	H		-1	-1	1	1	1
Magnetomotive force (mmf)	h			-1	1	1	1
Magnetic flux	Φ	1	1	1	-1		1
Magnetic pole strength (defined by $pH = F$)	p	1	1	1	-1	-1	-1
Wave impedance	Z_w	1	1	1	-2	-1	-1

The names of unit quantities in emu and MKS transitional units are as follows:

Quantity	*emu*	*MKS Rationalized Transitional Units*	*MKS Unrationalized Transitional Units*
H	oersted	ampere-turn sphere per meter	ampere-turn steradian per meter
h	gilbert	ampere-turn sphere	ampere-turn steradian
Φ	maxwell	weber	weber
p	maxwell	weber per sphere	weber per steradian
Z_w	–	ohm per turn sphere	ohm per turn steradian
S	steradian	sphere	steradian

The unit of plane angle is not affected by rationalization. The paradoxical relationships can now be shown to resolve themselves into the following equalities:

1 oersted $= 1{,}000/4\pi$ ampere-turn spheres per meter
$= 1{,}000$ ampere-turn steradians per meter

1 gilbert $= 10/4\pi$ ampere-turn spheres
$= 10$ ampere-turn steradians

1 maxwell (of magnetic flux) $= 10^{-8}$ webers

1 maxwell of pole strength* $= 4\pi \times 10^{-8}$ webers per sphere
$= 10^{-8}$ webers per steradian

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*Or better, 1 maxwell per steradian

The intrinsic impedance of space is both 120π ohms per turn sphere and 30 ohms per turn steradian. One suspects that the retention in common usage of the terms "ohms per square" and "ampere-turns," both of which arise from particular physical situations, is due to a similar feel for the dimensional character of directions in space.[4]

To sum up, raising the constants S and U to dimensional status can be justified on the grounds that they are constants of proportionality in the defining equations.[3,5] Supplying names to S and U, by association with angles, [3,6] leads to "transitional units" and gives not only a method, but also a terminology based on the nature of the problem. This provides a common language for parties wishing to communicate while yet retaining their individual systems. It allows anyone to pass freely from one system of units to another without fear of paradox or inconsistency.

Very truly yours,

Leo Young (M '56)

(Engineer, Westinghouse Electric Corporation, Electronics Division)

References

1. Editorial. *Wireless Engineer*, London, England, Sept. 1949.

2. E. Brylinsky. *Revue Generale de l'Electricite*, Mar. 1949.

3. Electrical Units and Dimensions, Leo Young. AIEE *Transactions*, vol. 75, pt. I, 1956 (Jan. 1957 section), pp. 767-71.

4. Elements of Modern Physics (book), W. C. Michels, A. L. Patterson. D. Van Nostrand, Inc., Princeton, N. J., 1951, pp. 265-68, 629-30.

5. Differences of Opinion about Dimensions, R. O. Kapp, *Proceedings*, The Institution of Electrical Engineers, London, England, vol. 104, part B, 1957.

6. Electrical Engineering (book), F. T. Chapman, A. N. Dover. Longman, Green and Co., London, England, 1956, Appendix C.

Library Services

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NEW BOOKS

The following new books are among those recently received at the Engineering Societies Library. Unless otherwise specified, books listed have been presented by the publishers. The Institute assumes no responsibility for statements made in the following summaries, information for which is taken from the prefaces of the books in question.

AMERICAN INSTITUTE OF PHYSICS HANDBOOK. Sponsored by the American Institute of Physics. Published 1957, by McGraw-Hill Book Company, Inc., 330 W. 42nd St., New York 36, N.Y. Various pagings, 6¼ by 9½ inches, bound. $15. This volume, prepared by more than 90 specialists, is the first handbook specifically on physics to be published in the United States. Over a hundred subject areas are covered in the 8 sections of the book: mathematics, mechanics, heat, sound, electricity and magnetism, optics, atomic and molecular physics, and nuclear physics. Throughout the book, there are numerous tables, graphs, and summaries of formulas in all fields of physics.

AUTOMATION IN BUSINESS AND INDUSTRY. Edited by E. M. Grabbe. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y., 1957. 611 pages, 6 by 9⅜ inches, bound. $10. Based on a series of lectures given at the University of California, this book presents the fundamentals of automation, new developments and techniques, and descriptions of automation systems applications. Emphasis is placed on new developments and applications of control systems that can perform both complex control functions and data processing, as in the chapter on analog computers in industrial control systems. Components are dealt with at the beginning, and systems later. References are included.

BRITISH ELECTRICAL POWER CONVENTION PROCEEDINGS, 1956. Available from the Secretary, British Electrical Power Convention, London, England. 630 pages, 5⅝ by 8¾ inches, bound. Price not given. In keeping with the theme of the convention—"Electricity and Transport"—all but one of the 10 technical papers included in these proceedings are devoted to various aspects of this subject: electric locomotives, electricity supply for railroads, railway signalling systems, trolley cars, trolley buses, and battery operated vehicles. The 10th paper is a study of costs and equipment for the house relying solely on electricity for heating, cooking, hot water, etc.

BUILDING AN ENGINEERING CAREER. By C. C. Williams and E. A. Farber. McGraw-Hill Book Company, Inc., 330 W. 42nd St., New York 36, N.Y., third edition, 1957. 299 pages, 6 by 9¼ inches, bound. $4.75. This is a text for an orientation course. The varied subject matter includes: achievements in many fields of engineering; efficient study methods; and the nature of engineering thinking. For an over-all view, a history of the engineering profession, from the Egyptians to the 20th Century technology is presented, together with its ethics and cultural ideas.

ELECTRICAL ENGINEERING CIRCUITS. By H. H. Skilling. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y., 1957. 724 pages, 6 by 9¼ inches, bound. $8.75. A text for a one-year undergraduate course. About two thirds of its coverage is devoted to traditional topics treated from a contemporary viewpoint. Some advanced topics and modern concepts covered are: network theorems, loop and node equations of networks, locus curves, and other graphical methods, Laplace transformation, electric filters, and poles and zeros in the complex frequency plane. The author's aim is to provide a treatment of elementary circuits that will lead effectively into the more advanced courses.

ELECTRONIC COMPONENTS HANDBOOK. Edited by Keith Henney and Craig Walsh. McGraw-Hill Book Company, Inc., 330 W. 42nd St., New York 36, N.Y., 1957. 244 pages, 8¾ by 11¼ inches, bound. $9. Intended mainly for designers of military electronic equipment, this book furnishes data on four components—resistors, capacitors, relays, and switches. For each of these, the book gives a general description of all types, describes the uses of particular types, and discusses the effects of heat, humidity, shock, vibration, etc., on their performance. A digest of military specifications covering each kind of component is given in the main text, and tables in an appendix summarize test procedures and military requirements for resistors and capacitors. The book was sponsored by The Electronic Components Laboratory of the Wright Air Development Center.

THE ELECTRONIC MUSICAL INSTRUMENT MANUAL. A Guide to Theory and Design. By Alan Douglas. Pitman Publishing Corp., 2 W. 45th St., New York 19, N.Y., third edition, 1957. 242 pages, 5½ by 8¾ inches, bound. $7.50. Every design phase of the modern electronic musical instrument is covered in this new edition. British, German, French, and American musical instruments are described, and the relationships between electrical tone colors and their acoustic counterparts is explained.

ELEKTRISCHE MESSUNG MECHANISCHER GRÖSSEN. By P. M. Pflier. Springer-Verlag, Berlin, Germany, fourth edition, 1956. 276 pages, 6⅛ by 9¼ inches, bound. DM 33. A thorough treatment of the electrical measurement of mechanical constants and quantities. The first two sections deal with the fundamentals of electrical measuring devices and the examination of their applicability to the determination of mechanical quantities. The third section demonstrates detailed procedures for the measurement of length, power, speed, acceleration, vibration, shock effects, and time.

ENGINEERING ENROLLMENT IN THE UNITED STATES. Edited by N. N. Barish. New York University Press, Washington Square. New York 3, N.Y., 1957. 226 pages, 6¼ by 9½ inches, bound. $7.50. Presents basic statistics on the subject in both tabular and graphic forms. The period covered varies but generally includes the last 25 to 35 years. In addition to general coverage, there are chapters on all major fields of engineering, and one chapter on engineering training in the U.S.S.R. Considers the effects of proliferation of curricula in engineering specialties, large-scale enrollment in graduate study, and attrition of engineering students. Concludes that the current shortage of engineering talent is critical with respect to engineers with a high degree of mathematical and scientific orientation and those with unusual analytic and design creativity.

EXTRACTION AND REFINING OF THE RARER METALS. Published 1957 by the Institution of Mining and Metallurgy, London, England. 444 pages, 5½ by 8¾ inches, bound. $8.50. This volume contains the proceedings of a symposium sponsored by the Institution of Mining and Metallurgy in London in 1956. The proceedings include 22 papers, with discussions, devoted to such subjects as purification by solvent extraction; recovery and concentration of uranium; chlorination of wolframite, vanadinite, and chromite; processes for producing pure niobium; and the manufacture of hafnium-free zirconium. Lists of references accompany most of the papers.

THE FUNDAMENTALS OF ELECTRIC LOG INTERPRETATION. By M. R. J. Wyllie. Academic Press, Inc., 111 Fifth Ave., New York 3, N.Y., second edition, 1957. 176 pages, 5 by 8¼ inches, bound. $4.50. An elementary text divided into two sections on the theory and the practice of quantitative log interpretation. Part I includes: what electric logs measure, nature of earth resistivity, and the basic principles of electric log interpretation. Part II includes: the induction log and its applications, contact logging devices, the MicroLaterolog, the neutron log method, and the acoustic velocity log. There is also a selected bibliography.

ACOUSTICAL ENGINEERING. By H. F. Olson. D. Van Nostrand Company, Inc., 120 Alexander St., Princeton, N.J., 1957. 718 pages, 6 by 9¼ inches, bound. $13.50. About one-third larger than the author's "Elements of Acoustical Engineering" 1947, on which it is based, the present volume has been revised throughout and includes two new chapters on complete sound reproducing systems, and means for the communication of information. Other chapters deal with such subjects as ultrasonics, underwater sound, speech, music, hearing, transducers, microphones, loudspeakers, and acoustical radiating and mechanical vibrating systems. References are scattered throughout the book.

ENGINEERING ECONOMY. By H. G. Thuesen. Prentice-Hall, Inc., Englewood Cliffs, N.J., second edition, 1957. 581 pages, 5⅜ by 8½ inches, bound. $6.95. The theory and practice of the determination and evaluation of economic factors are set forth for engineers and engineering students. In addition to general revision, this edition has a new chapter on income taxes in engineering economy studies. Other subjects treated in the book include: depreciation; first, fixed, variable, incremental, differential, marginal, and sunk costs; break-even and minimum cost points; evaluation of replacements; and economy and utilization of personnel.

TECHNICAL LITERATURE

The following recently issued technical literature may be of interest to readers of *Electrical Engineering*. All inquiries should be addressed to the issuers.

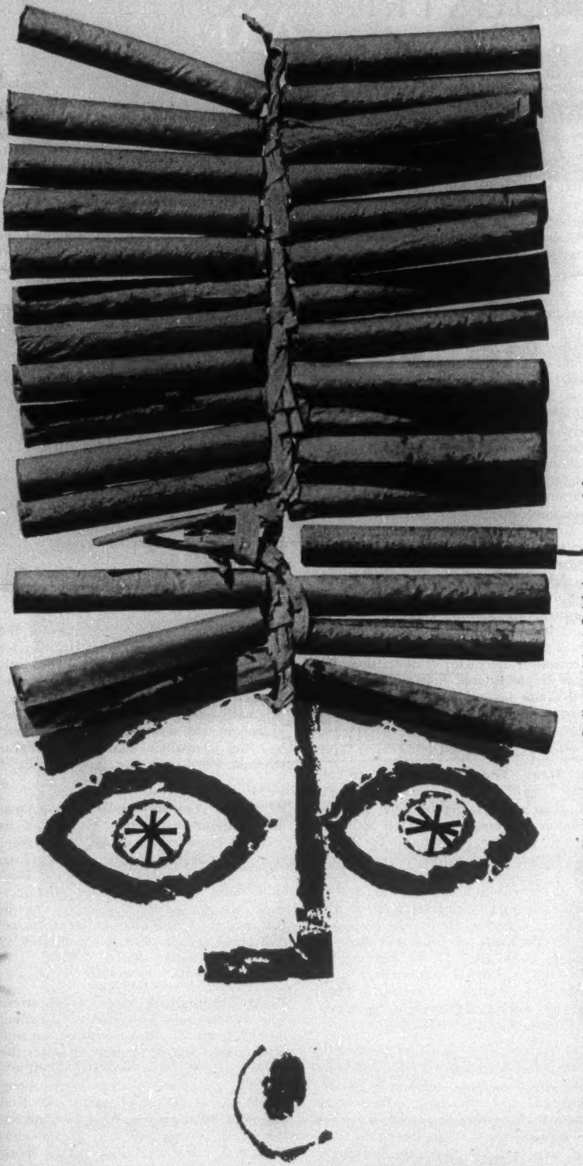
ANNUAL REPORT 1956: NATIONAL BUREAU OF STANDARDS, NBS MISCELLANEOUS PUBLICATION 220. 158 pages, 60¢ (Order from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.) This report summarizes the research and development activities of the National Bureau of Standards (NBS) in the physical sciences during the fiscal year 1956. Brief descriptions are given of representative accomplishments in each area of NBS responsibilities, which include maintenance of basic standards, determination of physical constants and properties of matter, development of methods and instruments of measurement, and the provision of calibration, testing, and scientific advisory services. During the past year, significant results were achieved in programs dealing with electronic computers, electronic instrumentation, and the properties of matter and materials. A new high-speed computer which gives the geographic fallout pattern after a nuclear explosion was developed for the Atomic Energy Commission (AEC). Development work was successfully completed on a microimage data storage and retrieval device which provides rapid access to any one of 10,000 microfilmed images located on a 10-inch-square sheet of film. The NBS also developed a technique for capturing and storing large numbers of free radicals—highly reactive molecular fragments—at temperatures near absolute zero. In the field of optics and metrology, NBS completed a comprehensive dictionary of color names, which lists some 7,500 individual color names and defines them in simple accurate terms easily understood by workers in different fields. A study of the effect of crystal orientation of fatigue crack initiation in metal was also completed. The Annual Report is composed of five sections: (1) a general review or summary, (2) a resume of NBS research and development work in progress or completed during 1956, (3) a review of the testing and calibration program, (4) a discussion of the various co-operative activities of NBS, and (5) an appendix consisting primarily of statistical and organizational material and a complete list of publications by staff members for the fiscal year. Foreign remittance must be in U. S. exchange and should include an additional one fourth the publication price to cover mailing costs.

SATISFYING SALARIED EMPLOYEES. The National Association of Manufacturers (NAM) has issued this new study which is described as a practical manual ". . . for building better relations with all categories of white-collar people." These groups include technical and professional, clerical and stenographic, supervisory and administrative, engineering and scientific, sales and research, and staff personnel. The study —the latest addition to the NAM's continuing campaign to help management meet the needs of white-collar people—covers four areas which the NAM says hold the answers to job satisfaction in the office and laboratory. They are status and recognition, compensation, communication, and supervision. The 64-page booklet sets forth sound practices in each area. It is designed to help employers find out what salaried workers want in their job, and then point up ways and means of providing these job satisfactions. Because the number of white-collar workers has been increasing steadily (they now total 25.4 million compared with 24.9 million production workers) the NAM appointed about a year and a half ago an advisory group on salaried personnel. The group is headed by C. F. Hawker, vice-president, Armstrong Cork Company, and includes representatives of Du Pont, Eastman Kodak, General Motors, General Electric, Ford, Goodrich, and other companies that are leaders in the industrial relations field. This committee has been exploring the entire area of personnel and human relations, communications, and supervisory problems in relation to the salaried worker. The results of the committee's work are included in the new booklet which is available at 50¢ a copy at the NAM's headquarters, 2 East 48th St., New York 17, N. Y.

TRANSISTOR FEEDBACK AMPLIFIER DESIGN. G. L. Benning, University of California for Office of Naval Research. October, 1955. 29 pages, 75¢. Order *PB 121556* from Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. A method was devised for design of a multistage wideband transistor incorporating constant resistance ladder networks in the external feedback path. The method allows synthesis of the feedback amplifier without use of equivalent circuits for the transistors. This is accomplished by approximating the measured amplifier gain function without feedback with a rational function of frequency, then applying unilateral feedback theory in design of the feedback path. Interaction effects are eliminated by use of contant resistance ladder networks in the feedback path. Among other advantages, the method is said to reduce design time considerably through use of equipment such as a complex plane analyzer or Spirule, and applying root locus techniques.

SYMPOSIUM ON MINIMUM PROPERTY VALUES OF ELECTRICAL INSULATING MATERIALS—STP 188. This symposium was presented at a meeting of the American Society for Testing Materials (ASTM) Committee D-9 on Electrical Insulating Materials, held in February 1956, in Philadelphia, Pa. There is occasional facetious reference to the factor of safety as the "factor of ignorance." This has some basis in fact for such a reference. In the design of electrical equipment, for example, the safety factor is based on the minimum expected values for electrical and physical properties of the component materials, as well as an estimate of the extremes of conditions which the equipment may encounter under adverse circumstances. Results of materials tests should enable a prediction as to the lowest expected value for a property of a material so that the designer may take this into account in establishing the safety factor. Unfortunately, this information is not readily obtainable from many present test methods. Although there has been some progress in establishing procedures for predicting minimum values, there is still great need for further work. This symposium may be considered as a report of progress, indicating a baseline for additional investigations toward establishing safety factors on a basis of knowledge rather than ignorance. Copies of this 50-page publication may be obtained from the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., price $1.75; to ASTM members, $1.35.

SRI JOURNAL. The first issue of the quarterly Stanford Research Institute (SRI) *Journal* was published in April 1957, according to an announcement by E. F. Carter, director of SRI. The new publication presents scientific and economic subjects in comparatively nontechnical language. It is designed primarily for research directors and key executives in business, industry, and Government. Editor of the 32-page magazine is Charles Scarlott, manager of SRI's publication department. The *Journal* features articles by staff members and guest contributors, as well as selected papers presented at SRI-sponsored meetings. Interpretive summaries of research projects also are included. The first issue of the *Journal* included articles by E. V. Murphree, special assistant for guided missiles, Office of the Secretary of Defense; N. H. Jacoby, dean of the Graduate School of Business Administration, University of California at Los Angeles; Kenneth Eldredge, Fred Kamphoefner, and Paul Wendt of SRI's Control Systems Laboratory; and Dan McLachlan, Jr., fundamental research scientist at SRI. Copies of the *Journal* may be obtained from the Editor, SRI *Journal*, Stanford Research Institute, Menlo Park, Calif. Cost is $1 a copy, $4 per year.



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The challenge is exciting. In Los Angeles, our major effort is the continuing development program for the Army's Corporal. In Monterey – Carmel-by-the-Sea, our new Engineering Lab is also blazing trails in guided missile and related fields. And don't discount this big dividend: while your career is going up, your family (and you) will enjoy living it up in California!

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INDUSTRIAL NOTES

Turbine Generators to Japan. Two 156,250-kw turbine generators, among the largest ever exported by Westinghouse Electric Corporation, Box 2278, Pittsburgh, Pa., have been sold to two utility companies in Japan. The high efficiency units, which will add over 2 billion-kw hours annually to the power supply of southern Japan, will be installed at the Karita station of Kyushu Electric Power Company, and at the Osaka station of Kansai Electric Power Company.

Titanium Casting Research. Oregon Metallurgical Corporation, P.O. Box 311, Albany, Oreg., has in operation a 100-pound capacity consumable electrode furnace for producing titanium and zirconium castings. Because titanium and zirconium in the liquid state react with every known element except argon and helium, the mold itself must be contained in the melting furnace. Castings will soon be available as pure titanium, zirconium, or alloyed with aluminum, vanadium, tin, chromium, manganese, molybdenum, or in almost every conceivable alloy combination. The most important physical characteristics of titanium are its strength-to-weight ratio and its corrosion resistance. Zirconium has a growing potential as a structural material in atomic power reactors because of its low rate of absorption of thermal neutrons and its resistance to corrosion at reactor temperatures. Requests for additional information should be directed to Stephen Shelton, General Manager, Oregon Metallurgical Corporation, Albany, Oreg.

Salt Spray Testing Chamber. An all-Lucite (registered trade mark) salt spray test chamber for determining salt fog corrosion resistance of materials and components, has been introduced by Associated Testing Laboratories. The chamber finds wide application for environmental salt spray tests in the electronic, instrument, aviation, marine, general metals, and other industries, and meets the exacting requirements of military specifications such as *Mil-E-5272A* and *QQ-M-151A*. For additional information, write directly to William Tonkowich, Chief Engineer, Associated Testing Laboratories, 412 Clinton Rd., Caldwell, N. J.

Bookkeeping Machine. A high-speed bank bookkeeping machine, combining electromechanical and electronic principles to bring a high degree of automation to the time-consuming posting operation, has been developed for sale by Burroughs Corporation, Detroit 32, Mich. Called the "Sensitronic," the compact new machine uses electronic components and magnetic code stripes to perform most of the posting operations without assistance from an operator. The Sensitronic is able to handle a variety of forms, permitting bankers to specify the printed results desired on the form.

Mobile Unit Demonstrates Air Breaker. Federal Pacific Electric Co. is now bringing "the Mountain to Mohammed" to introduce the company's new type *DST* air circuit breaker to utility executives and consulting engineers. The breaker is transported in an all-weather highway truck for demonstrations in the field or downtown offices in western states. The air breakers are supplied with 5- and 15-kv ratings for continuous 2,000-ampere loads. The 15-kv unit will satisfactorily interrupt 500-kva loads. Features of the breaker design include metal cladding for indoor or outdoor service, unusually rugged drawout construction. Federal Pacific type *DST* air circuit breakers, originally designed and built in San Francisco, are now being manufactured by the company's Eastern Switchgear Division, 888 Keyser Ave., Scranton, Pa.

Relocation. The Heywood-Robinson Company announces the new location of its architect-engineering, design, and executive offices in The Engineering Building, 114 Liberty St., New York, N. Y. Heyward-Robinson, a diversified architect-engineering organization specializing in the industrial field, has enlarged its activities to include construction as well as plant and building design.

Power Equipment, Largest Synchrotron. The Westinghouse Electric Corporation, Box 2278, Pittsburgh, Pa., will be the supplier of electrical equipment to power the world's largest atom smasher at Brookhaven National Laboratory, Long Island, N. Y. The equipment will feed power to 240 magnet cores which are arranged in a ring 842 feet in diameter. Around this ring will speed protons (positively charged atomic particles) with energies of 25 to 30 billion electron volts the highest ever attained. Brookhaven scientists expect that the new synchrotron on Long Island will provide further valuable information about the atom, its nuclei, and the forces responsible for holding particles of the nucleus together.

(Continued on page 20A)

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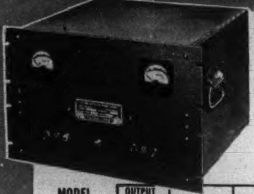
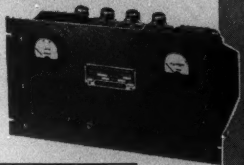


MODEL KR-16MC

1.5 Amp. KR SERIES

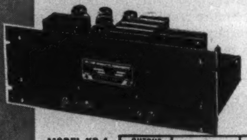
OUTPUT VOLTS DC	6.3V AC	Model	Rack Mount W	Rack Mount H	Rack Mount D	Price
0-150	Each supply	KR16	19"	12¼"	17"	$625
100-200	has two	KR17	19"	12¼"	17"	$625
195-325	15 Amp.	KR18	19"	12¼"	17"	$695
295-450	outputs	KR19	19"	12¼"	17"	$695



MODEL KR-8M

600 ma. KR SERIES

OUTPUT VOLTS DC	6.3V AC	Model	Rack Mount W	Rack Mount H	Rack Mount D	Price
0-150	Each supply	KR 8	19"	10½"	13"	$330
100-200	has two	KR 5	19"	10½"	13"	$240
195-325	10 Amp.	KR 6	19"	10½"	13"	$240
295-450	outputs	KR 7	19"	10½"	13"	$250



MODEL KR-4

300 ma. KR SERIES

OUTPUT VOLTS DC	6.3V AC	Model	Rack Mount W	Rack Mount H	Rack Mount D	Price
0-150	Each supply	KR 12	19"	7"	11"	$270
100-200	has two	KR 3	19"	7"	11"	$180
195-325	5 Amp.	KR 4	19"	7"	11"	$180
295-450	outputs	KR 10	19"	7"	11"	$190

MODEL KR-1C

125 ma. KR SERIES

OUTPUT VOLTS DC	6.3V AC	Model	Rack Mount W	Rack Mount H	Rack Mount D	Price
0-150	Each supply	KR 11	19"	7"	11"	$180
100-200	has one	KR 1	19"	7"	7½"	$ 90
195-325	3 Amp.	KR 2	19"	7"	7½"	$ 90
295-450	output	KR 9	19"	7"	7½"	$ 97

To Include 3" Current and Voltage Meters, Add M to Model number (e.g. KR 16-M) and Add $30.00 to the Price.
To Include Dust Cover and Handles for Table Mounting, Add C to Model number (e.g. KR16-C) and Add $10.00 to the Price.
To Include Meters, Dust Cover and Handles, Add MC to Model number (e.g. KR-16 MC) and Add $40.00 to the Price.

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★ FAST RECOVERY TIME ★ GOOD STABILITY ★ LOW OUTPUT IMPEDANCE

Kepco **KR** Voltage Regulated Power Supplies are conservatively rated and are designed for continuous duty at 50°C ambient.

REGULATION: Less than 0.2 volts for line fluctuation from 105-125 volts and less than 0.2 volts for load variation from 0 to maximum current.

RIPPLE: Less than 3 mv. rms.

STABILITY: The output voltage variation is less than the regulation specification for a period of 8 hours.

RECOVERY TIME: Less than 50 microseconds. The excursion in the output voltage during the recovery period is less than the regulation specification.

OUTPUT IMPEDANCE: Less than 0.1 ohms from 20 cycles to 100KC. Less than 0.5 ohms from DC to 20 cycles. Many units have very much lower output impedance.

featuring

- Fast recovery time, suitable for square wave pulsed loading.
- Voltage range continuously variable without switching.
- Either positive or negative may be grounded.
- Advanced vacuum tube regulator circuitry.
- Power requirements 105-125 volts, 50-65 cycles.
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- Guarantee one year.

All models available for 400 cycle operation on special order.

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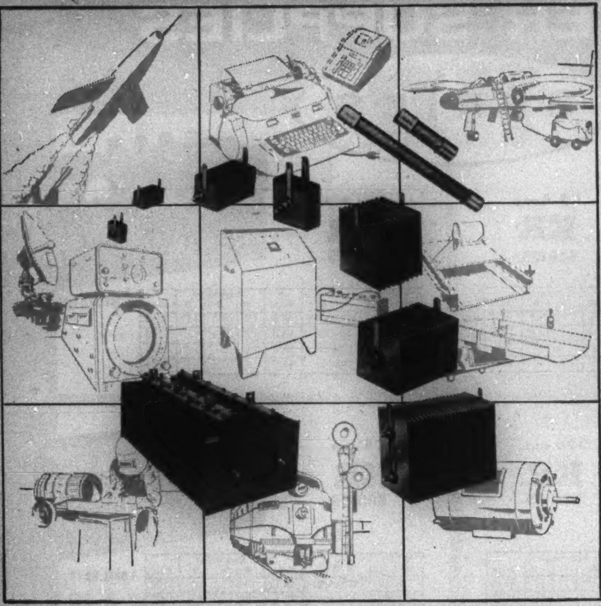
SYNTRON Vacuum Process

SELENIUM RECTIFIERS



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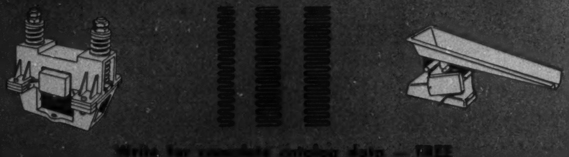

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Circle 16 on the card.

(Continued from page 18A)

Industrial Notes

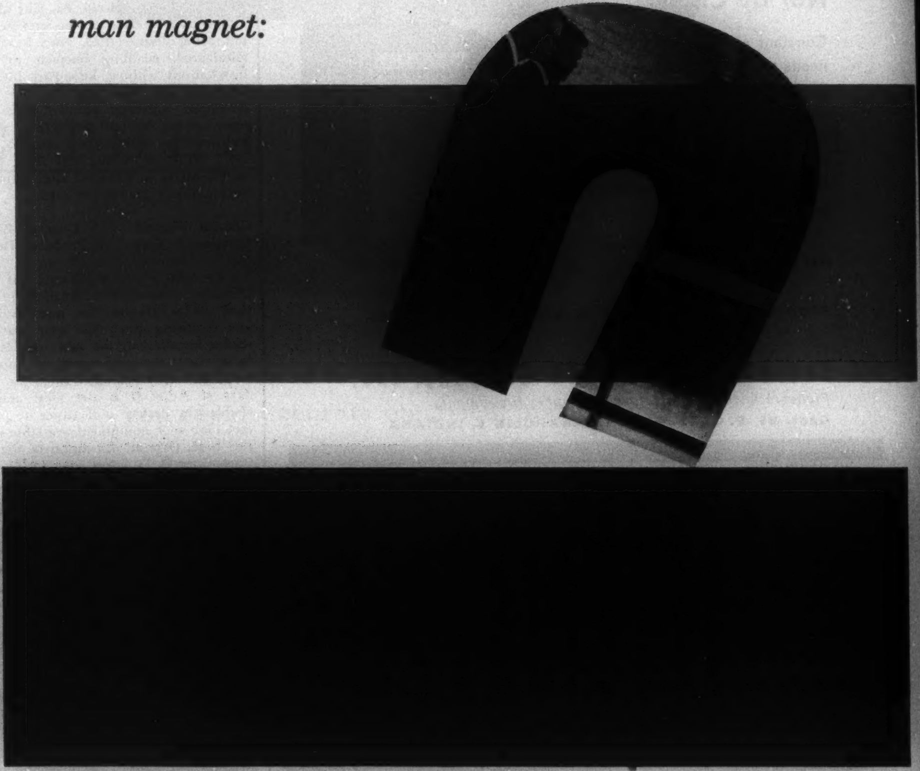
New Automation System. More complete automation than has previously been possible in getting goods from factory to consumer is a feature of a radically new distribution system unveiled by the Mangel Stores, a nation-wide retail chain. The system was designed, engineered, and installed by the Dasol Corporation, 14 Charlton St., New York, N. Y., a firm of consulting engineers who have pioneered in the application of automation, data processing, and linear programming to distribution engineering. In this new system, automatic electronic controls guide the flow of all clothing. The goods are received, sorted, inspected, marked, ticketed, accumulated, packed, and stacked in the trucks of one of 12 different over-the-road carriers that will carry them to 124 stores across the country. Over and above economies in direct manpower, there are substantial savings resulting from an elimination of overtime operations during peak periods. There are other material savings in rent, inventory, insurance, taxes, etc., along with those resulting from a considerable elimination of the possibility of human error. Finally, a more rapid turnover in merchandise means more effective merchandising and a more efficient use of capital.

Electronic Brain in County Office. The leasing of an electronic brain expected to save Los Angeles County an estimated $500,000 a year was approved by the Board of County Supervisors. The Board voted to install a Datamatic *1000* electronic data-processing system in the assessor's office. This saving will be over and above the $47,305 monthly rental. The installation will be the first of its kind in county government. The Board said the move toward streamlined operating procedures reflected the planning needed to keep up with the rapid growth of the County. Datamatic Corporation, manufacturer of the data-processing system, is owned jointly by Minneapolis-Honeywell Regulator Co. and Raytheon Manufacturing Co.

HKP Company Acquisition. H. K. Porter Company, Inc., 300 Park Ave., New York 22, N. Y., has announced acquisition of Federal Wire & Cable Company, Ltd., Guelph, Ont., Canada. Acquisition of Canada's fourth largest wire and cable concern was made by H. K. Porter Company (Canada) Ltd., a wholly owned Porter subsidiary. Federal products include cable for the aluminum, aircraft, automotive, and electrical industries. Wire is manufactured for the appliance, building, radio, and telephonic industries. Among other products are automotive and special harness assemblies to customer requirements. Both the plant and headquarters offices of Federal are located in Guelph; sales offices are in other Canadian cities.

(Continued on page 24A)

man magnet:



ElectroData is a magnetic field, irresistible to men of the right metal – men who respond to opportunities for creative achievement and the twin inducements of good salary and ideal working climate. Those opportunities are here, in the rapidly expanding field of electronic data processing and its many unexplored new applications. Men who are able to accept creative assignments, assume increased responsibility and make practical contributions to the science of electronic data processing are invited to join us. Write: Professional Employment Manager, ElectroData, 460 Sierra Madre Villa, Pasadena, California.

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Constant attention to the wants and needs of users, has been worked into the finished recorder by trained designers, who devote their entire effort to producing the best in direct-writing recorders. *E-A Recorders are designed to be the best.* Performance has proved their superiority.

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A COMPLETE LINE OF DRY TYPE AND LIQUID-FILLED [illegible]

(Continued from page 20A)

NEW PRODUCTS

New Line of Clamps. Smoother, quicker cable installation, without the usual fumbling for loose parts, is made possible by a line of clamps introduced by Aluminum Company of America, 1501 Alcoa Building, Pittsburgh 19, Pa. The clamps, known as *480* Series, can be applied without being disassembled. Nuts have been eliminated, enabling linemen to make installations without loose-part interruptions. An additional timesaver is a newly developed universal parallel groove design, making it possible for three clamps to cover the full range from No. 2 to 397.5 MCM in ACSR, and from No. 2 to 400 MCM in stranded aluminum conductor. *Circle 200 on the card.*

General Electric. The General Electric Company's Technical Products Department, Electronics Park, Syracuse, N. Y., has unveiled a new 50,000-watt AM radio broadcast transmitter. Smaller in size than 50-kw transmitters now available and requiring much less floor space for studio installation, the new unit is said to represent the most significant improvement in such equipment since the early days of radio. It is also more reliable, simpler in design, and easier to maintain than such equipment available up to this time. Over-all dimension of the new transmitter is 13½ feet long by 4½ feet deep. *Circle 201 on the card.*

Breadboard Layout Eliminated. An instrument that eliminates breadboard layout by simulating complete transistorized amplifier stages has been introduced by the Sprague Products Company, 321 Marshall St., North Adams, Mass. It is called the Sprague *LF-1* Transimulator. The *LF-1* Transimulator is available now direct from major electronic parts distributors across the United States. *Circle 202 on the card.*

High Speed Bulb Blowing Machine. An automatic bulb blowing machine that moulds glass envelopes for incandescent lamps, radio tubes, Christmas tree ornaments, and similar products has been announced recently. Capable of production speeds up to 2,400 units per hour, a typical model No. *2070* can handle sizes up to 2½ inches OD by 5½ feet over-all length including stem or tubulation. Incorporating the standard Kahle index by barrel cam and rollers, the bulb blowing machine is fully automatic except for manual loading of 4-foot lengths of glass. Oil-immersed and enclosed to reduce maintenance, the rollers are precision tapered, hardened, and ground to insure accuracy. Complete information regarding equipment for the production of electron tubes, semiconductors, lamps, and similar devices may be obtained by writing Eli Stiefel, Kahle Engineering Company, 1400 Seventh St., North Bergen, N. J. *Circle 203 on the card.*

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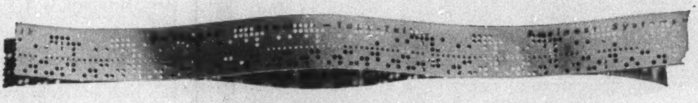
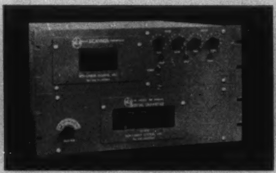
EITHER WAY OR BOTH



...in a clear numerical form or a printed record NLS gives you rapid, accurate electrical measurements.

The vital accuracy in electrical measurement instruments that today's exacting sciences demand is provided by Non-Linear Systems, Inc. Not only are NLS digital instruments unsurpassed in speed, dependability and long life, but their visual readout performance may be supplemented by printed data recorders. Thus, visual reading may be done by unskilled personnel while printed or punched paper data is also recorded for future study. Complete, pre-engineered automatic test systems can be established by adding input scanners to NLS digital instruments, permitting sampling of up to one thousand stations. Oil immersed stepping switches – an exclusive NLS feature – assure constant accuracy and trouble-free long life of both NLS digital voltmeters and ohmmeters. The NLS line of digital instruments covers a wide range of engineering and scientific electrical measurement applications. Whatever your needs in this field, NLS can meet your most exacting requirements in instruments and systems. Your inquiry will be welcomed.

Clary Printers (both 8 column and 11 column) are supplied by NLS to be used in connection with DC digital voltmeters, 4 digit and 5 digit AC/DC voltmeters or ohmmeters.



Input scanners used with NLS digital voltmeters or digital ohmmeters provide for automatic scanning of many inputs and when used with data recorders provide complete automatic systems.

Flexowriter equipment for typewriting of data and simultaneous paper tape punching may be used with NLS digital voltmeters and ohmmeters. NLS Flexowriter converters are provided for this purpose.

Originators of the Digital Voltmeter

non-linear systems, inc.

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Digital Ohmmeters • AC-DC Converters • Data Reduction Systems • Digital Readouts
Peak Reader Systems • Binary Decimal Converters • Digital Recording Systems

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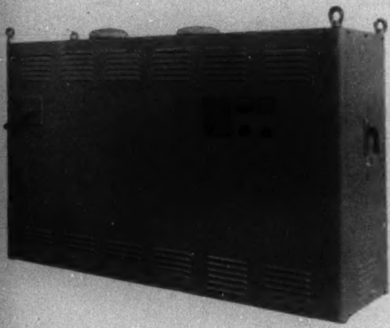
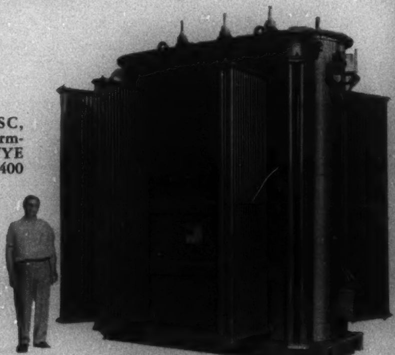


300 KVA indoor unit substation or load center consisting of high voltage fused air break switch and low voltage section with circuit breakers and metering.

Good planning, with the aid of Standard Transformer Company engineers, will help you stay ahead of your expanding power needs. Standard will work with you to design and build the custom transformers which meet your needs best, and you'll pay no more than you pay for repetitive models. Check with Standard now. Just tell us your present and anticipated needs. Your inquiries will receive immediate attention.

7500 KVA, OISC, three-phase transformer, 34,400 volts WYE primary, 4180Y/2400 volts secondary.



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REPRESENTATIVES IN PRINCIPAL CITIES

Circle 23 on the card.

(Continued from page 24A)

New Products

Ultrasonic Cleaner. A portable, lightweight, ultrasonic cleaner, Glennite Model *U-621*, designed for industrial cleaning of small precision parts, is announced by the Vibro-Ceramics Division, Gulton Industries, Inc. Small metal parts, glass and ceramic such as electromechanical instruments, small aircraft instruments, watch parts, small diameter tubing and delicate research and medical instruments, can be cleaned in as little as five seconds. The *U-621* also has application in the chemical industry for the agitation of liquids and for experimental processing such as emulsification and demulsification. For additional information, write to Lawrence C. Oakley, Engineering Sales Manager, Gulton Industries, 212 Durham Ave., Metuchen, N. J. *Circle 204 on the card.*

Flight Information System. A system for automatic transmission of flight information from aircraft to ground control centers has been developed by Stromberg-Carlson, a Division of General Dynamics Corporation, Rochester 3, N. Y., and is expected to become an important aid in air traffic. Called LABIL (Light Aircraft Binary Information Link), it enables an aircraft pilot to transmit automatically 13 separate categories of flight information to a control tower with the flip of a switch. The airborne, or mobile, unit of the LABIL system is 13 inches high, 10 inches wide, and 6 inches deep, and weighs only 25 pounds. Although designed especially for light aircraft application, the small size, light weight, low power consumption of the unit, and the fact that the basic form of data is general in nature, makes the system equally applicable to any other situation in which data reports from mobile remote locations must be made quickly and reliably. Tanks and observation vehicles are typical examples of other possible uses. *Circle 205 on the card.*

Transistor Header Machine. A machine that produces quality metal-flanged stems for transistors and similar components has been announced by Kahle Engineering Company. The transistor header machine produces up to 800 units per hour. Incorporating 12 heads with individual upper and lower molds, the Kahle machine differs from the standard all-glass subminiature stem machine in that each head position utilizes a precise die that correctly positions and holds the metal flange or ferrule. Unloading is automatic. The transistor header machine can be supplied in a wide selection of types and capacities with or without automatic programming. It features the Kahle indexing mechanism for reliable production and a dual motor drive. For more information, write Kahle Engineering Company, 1400 Seventh St., North Bergen, N. J. *Circle 206 on the card.*

(Continued on page 33A)

(Continued from page 26A)

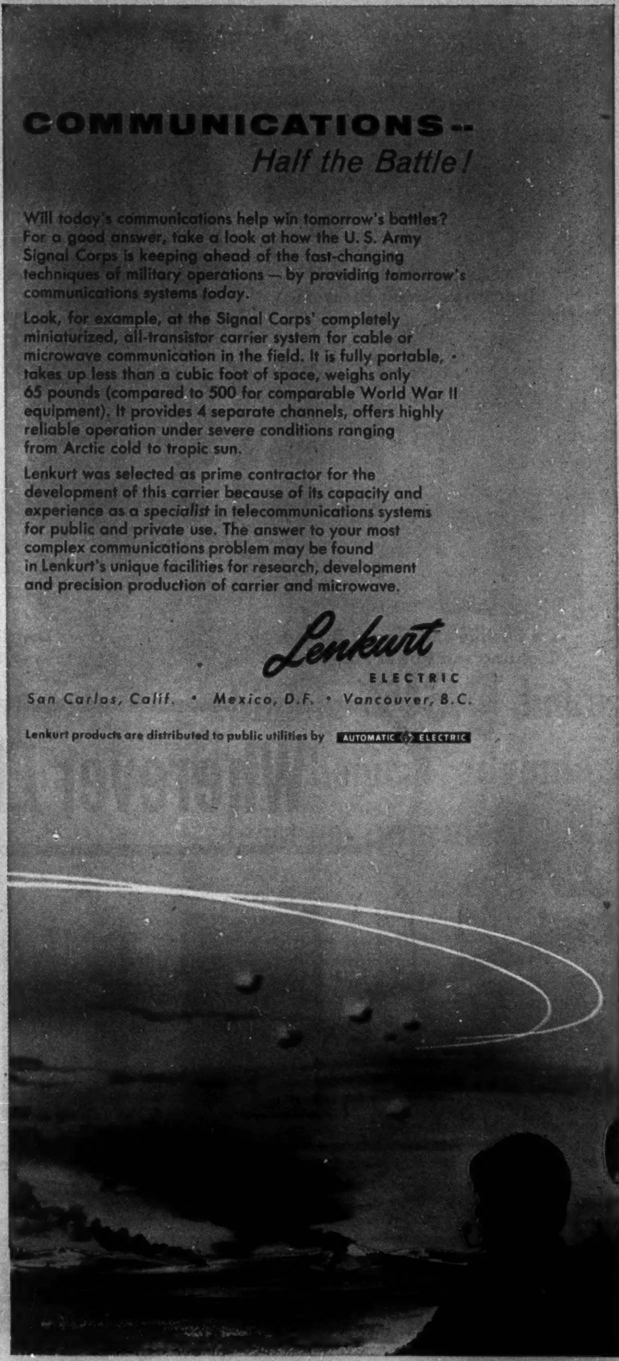
New Products

Transmitter–Receiver. This matched transmitter–receiver pair for remote indication of angular position gives a linear output over a full 320-degree range. An almost unlimited number of receivers may be connected parallel to one transmitter without reduction of standard 3% accuracy. The receiver has positions for "zeroing in" at the upper and lower limits of the scale. Receivers are available, at extra cost, having adjustable alarm or limit contacts at high, low, or both ends of the scale. The units are designed for rigorous service. For further information contact Certi-Fact Engineering, Inc., P. O. Box 774, Sherman Oaks, Calif. *Circle 207 on the card.*

Walking Magnetometer. A "Walking Magnetometer" claimed to be as revolutionary for oil and mineral prospecting as the Flying Magnetometer, is announced by the Radiac Company, Inc., 489 Fifth Ave., New York, N. Y. It is used to measure the vertical component of the earth's magnetic field for the solution of a wide variety of geophysical exploration problems. Used like a scintillometer or geiger counter, the Walking Magnetometer locates and delineates subsurface magnetic minerals directly, such as, magnetite and pyrrhotite and locates minerals of varying magnetic character and oil-bearing structures indirectly. *Circle 208 on the card.*

All-Glass Geiger Counters. Halogen quenched, all-glass geiger counters have been marketed at organic counter prices by Radiation Counter Laboratories, Nucleonic Park, Skokie, Ill. These low cost, all-glass tubes have infinite life and 20% higher gas counting efficiency than any other halogen counters. Neither light

(Continued on page 38A)



COMMUNICATIONS--
Half the Battle!

Will today's communications help win tomorrow's battles? For a good answer, take a look at how the U. S. Army Signal Corps is keeping ahead of the fast-changing techniques of military operations — by providing *tomorrow's* communications systems *today*.

Look, for example, at the Signal Corps' completely miniaturized, all-transistor carrier system for cable or microwave communication in the field. It is fully portable, takes up less than a cubic foot of space, weighs only 65 pounds (compared to 500 for comparable World War II equipment). It provides 4 separate channels, offers highly reliable operation under severe conditions ranging from Arctic cold to tropic sun.

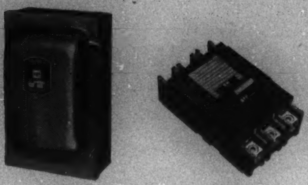
Lenkurt was selected as prime contractor for the development of this carrier because of its capacity and experience as a *specialist* in telecommunications systems for public and private use. The answer to your most complex communications problem may be found in Lenkurt's unique facilities for research, development and precision production of carrier and microwave.

Lenkurt
ELECTRIC

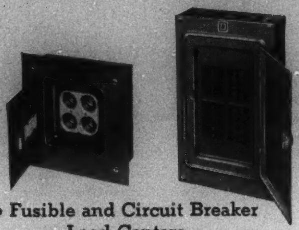
San Carlos, Calif. • Mexico, D.F. • Vancouver, B.C.

Lenkurt products are distributed to public utilities by AUTOMATIC ELECTRIC

Circle 29 on the card.

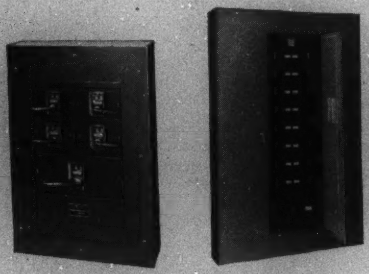


• Safety Switches and Industrial Circuit Breakers

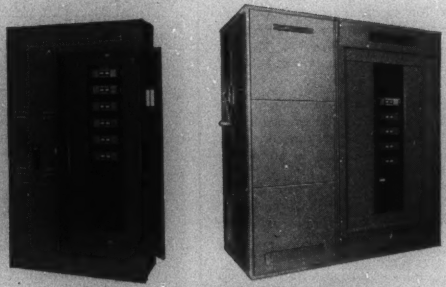


• Fusible and Circuit Breaker Load Centers

• Voltage Testers

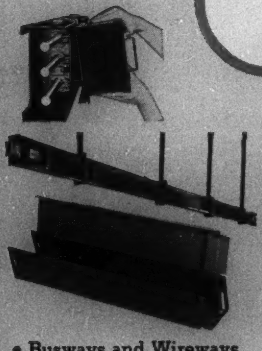


• Fusible and Circuit Breaker Lighting and Power Panelboards



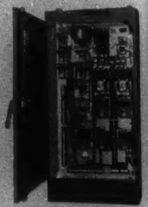
• Power Distribution Switchboards and Switchgear

Wherever Electricity



• Busways and Wireways

EC&M
High Voltage and
Synchronous Starters

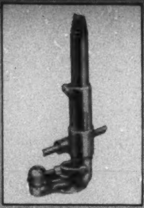


• Special Purpose Control

• Control Centers

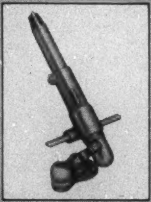
SQUARE D COMPANY

For more information circle 30 on reader service card.



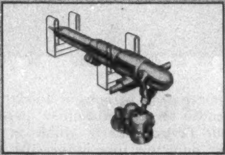
1. SWITCH BLADE IN FULLY OPEN POSITION

Universal link connects blade and crank arm for transmitting forces to the switch blade for full cycle of operation.



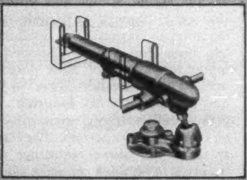
2. SWITCH BLADE CLOSING

Switch blade is moved from the open to closed position by a relatively small angular motion of the crank arm.



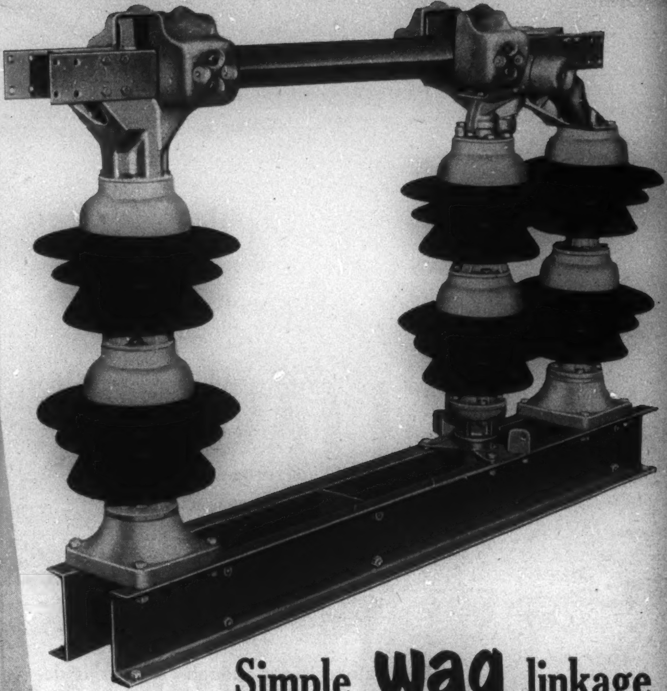
3. SWITCH BLADE ENTERS CONTACTS

In this position the switch blade begins its rotation for full contact engagement. Continued movement of the crank arm will rotate the blade to bring contacts under high pressure.



4. SWITCH WITH CONTACTS FULLY ENGAGED

The simple linkage of the WAG concentrates mechanical advantage so that contact engagement or disengagement is accomplished with a minimum of effort.



Simple **wag** linkage boosts mechanical advantage; lessens operating effort

In one sweeping, continuous movement the Type WAG Switch blade swings into the open or closed position. There is no lost motion — no cams, triggers, or latches.

The WAG is operated by a simple system of cranks and levers arranged to transmit maximum torque when the blade rotates to engage or disengage the contacts. By concentrating mechanical advantage where it is needed most, the WAG can be operated smoothly and with less effort.

Thus, the Type WAG offers the advantages that engineers recognize as so important: a switch easy to operate, higher contact pressure, and wider contact deflection. The Type WAG has the muscle to break up heavy concentrations of ice and to operate dependably under the most adverse conditions.

For a premium quality switch capable of long, reliable service, choose the Type WAG.

For more information circle 32 on reader service card.

SS®

SOUTHERN STATES
EQUIPMENT CORP.
HAMPTON, GEORGIA

IN CANADA: Dominion Cutout Co., Ltd., Toronto

STEEL PLATE FABRICATORS ASSOCIATION
FOUNDED 1933

CONCRETE REINFORCING STEEL INSTITUTE
C.R.S.I.
FOUNDED 1924

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STEEL CORPORATION

STEEL alone is not enough . . . nor is design, engineering, detailing, fabrication or distribution.

At Flint, four highly specialized divisions and the manufacturing facilities of two large plants provide services that many of Flint's customers find convenient and profitable to avail themselves of in part or all divisions.

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Write for illustrated brochure covering any or all divisions.

for over 40 years

FLINT STEEL CORPORATION
TULSA . . . MEMPHIS

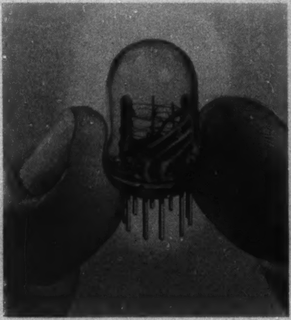
Circle 33 on the card.

(Continued from page 33A)

New Products

nor extreme temperatures affect the characteristics of these nonphotosensitive tubes. The tubes come in six basic models: civil defense counter, thin wall for survey meters, thin wall jacketed, general purpose thin wall, long thin wall, and mica counter window. *Circle 209 on the card.*

All-Electronic Miniature Read-Out Tube. This miniature, all-electronic device which converts electronic signals directly to readable characters, the miniature NIXIE, has been announced by the Electronic Tube Division, Burroughs Corporation, Plainfield, N. J. The miniature NIXIE is a gas-filled, cold cathode, 10-digit ("0" through "9"), numerical indicator tube having a common anode. It is intended for use as a direct, in-line, readout device. Clearly visible at 10 feet, the miniature tube utilizes 100 volts (approximately 40% less voltage than the standard size) and operates at 1/8 watt (1/3 less wattage). The miniature NIXIE is capable of being operated with the Burroughs beam switching tube, a mechanical switch or any suitable voltage source. For more information, write to the company. *Circle 210 on the card.*

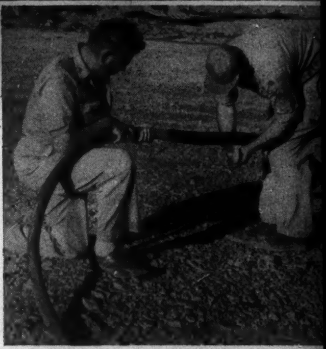


Decade Scaler. A new and improved version of a 10-mc decade scaler especially designed to improve the reliability factor has been announced. The design eliminates the source of most potential failures. These decade scalers are plug-in devices capable of counting electrical pulses and recurrent events up to a rate of 10 million per second. They are usable as drives for slower counting scalers to build up a bank of counters. The display is a scale of numbers lighted by neon bulbs. For further information contact Advertising Department, Laboratory for Electronics, Inc., 75 Pitts St., Boston 14, Mass. *Circle 211 on the card.*

(Continued on page 40A)

service drop

New Self-Fusing, All-Weather
SPLICING TAPE
scores solid hit



portable cables

phase color coding

At last! . . . an all-weather, self-fusing, flame-resistant splicing tape is on the market. This new, multi-purpose tape is already generating wide acceptance . . . the only self-fusing tape listed by the Underwriters' Laboratories for use as "sole insulation and covering of splices and joints in electrical conductors."

OKOWELD rapidly fuses into a solid, weather-resistant wall. It serves as *both* insulation and sheath on cables for operation up to 2000 volts . . . cannot unwrap or separate into layers like "adhesive" tapes.

Electrically strong, **OKOWELD** has excellent resistance to water, weather, ozone, chemicals, oils and most hydrocarbons.

OKOWELD's toughness makes it ideal for portable cables on rugged jobs . . . and it passes the Bureau of Mines Flame Resistance Test.

OKOWELD is easy to apply . . . either side is "up" . . . shapes smoothly over irregular surfaces . . . use in coldest weather.

Non-sticky, non-brittle, using no adhesives, **OKOWELD** is the "thousand-uses" splicing tape that never sits in the electrician's tool box waiting for a job. Ask your distributor for full facts today or write to The Okonite Company, Passaic, N. J.

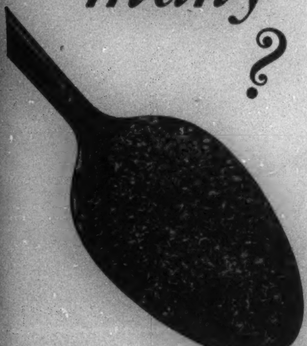
Sold only through authorized distributors

OKONITE SPLICING TAPES

5265

For more information circle 34 on reader service card.

how many ?



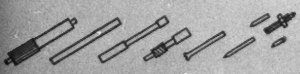
INSTRUMENT makers are using more and more Johnson pivots. Maybe you're one of them and can tell how many Johnson pivots are held in the teaspoon above.

There's a prize! No world beater, but a handy transistor portable radio to the closest guesser. In case of ties, earliest postmark will qualify.

But you needn't guess when you need precision pivots, accurately machined, scientifically hardened and polished to a metallographic finish. Direct your inquiry to Johnson for satisfaction.

Mail your estimate of the number of pivots in this regular teaspoon now to qualify for the prize. A postcard will do.

Welton V. Johnson
Engineering Company, Inc.



precision miniature parts

53 SUMMIT AVENUE
SUMMIT 2, NEW JERSEY

LA 1162

Circle 35 on the card.

(Continued from page 38A)

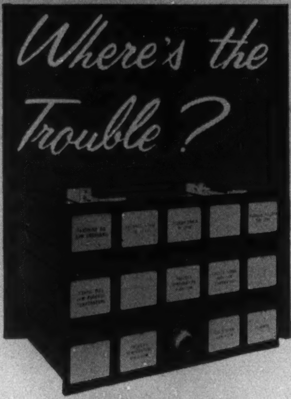
New Products

Miniature Waveguide Switches. A miniature waveguide switch has been announced by Airtron, Inc., for use on applications requiring minimum size and weight. It provides rapid switching of signals from any one of three positions to either of the remaining two and will not change to another position upon failure of its power supply. Electrical characteristics include a frequency range of 8,500 to 9,600 mc per second with a maximum voltage standing wave ratio of 1.10 and a minimum isolation of 40 db. The universal switch operates at 3.0 amperes maximum at 28 volts d-c nominal and employs r-f and pressurized fittings built into the switch, giving up to 20 pounds of pressurization throughout. They are available in X_s and X_L band series. Other frequency bands and special designs can be supplied. For more information, write Airtron, Inc., Dept. C., Linden, N. J. *Circle 212 on the card.*

Small Business Telephone System. Now small business establishments, too, can have all the advantages of private internal communications previously available only in large and costly systems. This is made possible by a 10-line, low-cost dial telephone system introduced by Special Products Division of Stromberg-Carlson, a Division of General Dynamics Corporation, Rochester, N. Y. This interphone system, Model *TDX-10*, offers all the functional features of Stromberg-Carlson's larger *Dial-X* systems. The new Model *TDX-10* provides dial tone, automatic one-digit dialing, continuous ringing with ring-back to caller, plus guaranteed privacy. Through a built-in switchboard connection, the *TDX-10* can be adapted easily to voice paging from any telephone by the addition of amplifier-speaker facilities. *Circle 213 on the card.*

Stripes in Tubing. In order to make it easier to identify process lines, electrical and electronic leads made from Teflon (registered trade name) tubing, Pennsylvania Fluorocarbon Co., Inc., 1115 North 38th St., Philadelphia 4, Pa., is now offering the tubing with axial stripes of any color including combinations. The striped tubing is available in any size. There is no danger of wearing away the stripes because they penetrate the full depth of the tubing. The tubing is unaffected by moisture and it is said to be ideally suited for electronic and electrical applications inasmuch as its service temperature of 250 C is more than 100 C above other materials used in these applications. In addition, the tubing simplifies the soldering technique because Teflon is unaffected by the hot barrel of the soldering iron. For complete details, write to the company. *Circle 214 on the card.*

(Continued on page 46A)



SCAM
SEQUENTIAL ANNUNCIATORS
Will Tell You!

Scam sequential annunciator systems provide an audible and flashing visual signal on the first alarm to enable the operator of your control board to determine which point in the monitored process first becomes abnormal . . . successive alarms that develop from the original abnormal condition are indicated by a steady visual signal. You can take proper corrective measures immediately because you *know* where the trouble started.

Shown here is a typical standardized Scam DE-LINE cabinet with integral flasher and reset pushbutton, featuring all the Scam advantages including simple, compact plug-in design.

If you've a process or system that needs automatic, fail-safe, low cost monitoring write us for literature or call the nearest representative in the cities listed below.

THE SCAM INSTRUMENT CORP.
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Phoenix • Pittsburgh • Portland • St. Louis
San Francisco • Seattle • Tulsa • Toronto
and Vancouver, Canada

Circle 36 on the card.

Amp-trap
KAB5000
FORM 480
55D

Amp-trap®

CURRENT LIMITERS
(not fuses)

Available in Ratings
from ¼ Amp. to 10,000 Amps.

FOR POSITIVE PROVEN PROTECTION ON ALL GENERAL POWER AND ELECTRONIC CIRCUITS

- **The ORIGINAL Current Limiter with ratings up to 5000 Amperes.**
- **The ONLY complete line of Current Limiters.**
- **The ONLY Current Limiter that has been proved both in the laboratory and on-the-job again and again.**
- **The ONLY Current Limiter that can interrupt 200,000 Amperes symmetrical over the entire Ampere Range.**

The Amp-trap is a true Current Limiter because it *stops* dangerous short circuit currents before they become destructive. Fuses can not do this on high power circuits.

REGISTERED UNITED STATES PATENT OFFICE
S
Est. 1893

AMP-TRAPS — *"Awake At The Switch"*
THE **CHASE-SHAWMUT** CO.
373 MERRIMAC STREET • NEWBURYPORT, MASSACHUSETTS

Represented in Canada
by Powerlite Devices, Ltd.

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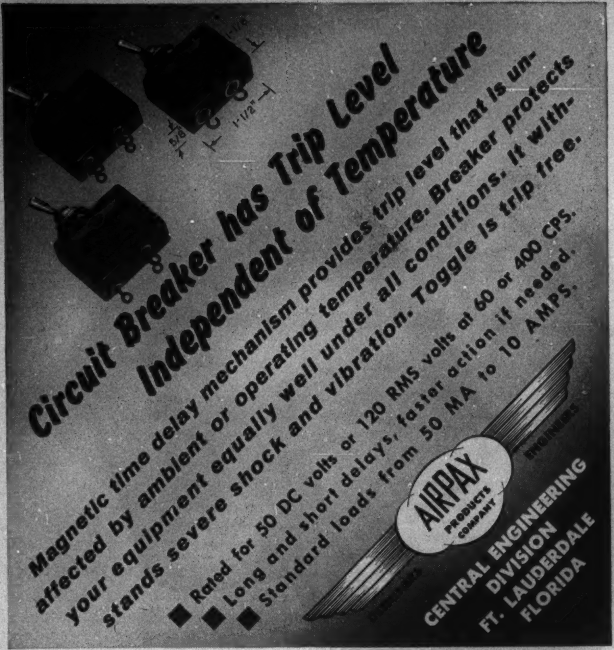
Subsidiary of I-T-E CIRCUIT BREAKER CO., Philadelphia, Pennsylvania



Circuit Breaker has Trip Level Independent of Temperature

Magnetic time delay mechanism provides trip level that is unaffected by ambient or operating temperature. Breaker protects your equipment equally well under all conditions. It withstands severe shock and vibration. Toggle is trip free.

- ■ Rated for 50 DC volts or 120 RMS volts at 60 or 400 CPS.
- ■ Long and short delays, faster action if needed.
- ■ Standard loads from 50 MA to 10 AMPS.

AIRPAX PRODUCTS COMPANY

CENTRAL ENGINEERING DIVISION
FT. LAUDERDALE
FLORIDA

▲ Circle 41 on the card.

▼ Circle 42 on the card.

TELEPHONE AND TELEGRAPH EQUIPMENT

Radio Engineering Products is currently producing a number of types of equipment, electrically and mechanically interchangeable with standard Bell System apparatus.

CARRIER-TELEPHONE EQUIPMENT

C5 Carrier-Telephone Terminal (J68756). A kit for adding a fourth toll-grade channel to existing C systems is available. • C1 Carrier-Telephone Repeater (J68757) • 121A C Carrier Line Filter • H Carrier Line Filter (X66217C).

CARRIER-TELEGRAPH EQUIPMENT

40C1 Carrier-Telegraph Channel Terminal (J70047C) • 140A1 Carrier Supply (J70036A1, etc.) • 40AC1 Carrier-Telegraph Terminal.

VOICE-FREQUENCY EQUIPMENT

V1 Telephone Repeater (J68368F) • Power Supply (J68638A1) • V1 Amplifiers (J68635E2 and J68635A2) • V3 Amplifier (J68649A) • V-F Ringers (J68602, etc.) • Four Wire Terminating Set (J68625G1) • 1C Volume Limiter (J68736C).

D-C TELEGRAPH EQUIPMENT

16B1 Telegraph Repeater (J70037B) • 10E1 Telegraph Repeater (J70021A) • 128B2 Teletypewriter Subscriber Set (J70027A).

TEST EQUIPMENT

2A Toll Test Unit (X63699A) • 12B, 13A, 30A (J64030A) and 32A (J64032A) Transmission Measuring Sets • 111A2 Relay Test Panel (J66118E) • 118C2 Telegraph Transmission Measuring Set (J70069K) • 163A2 Test Unit (J70045B) • 163C1 Test Unit (J70045D).

COMPONENTS AND ACCESSORIES

255A and 209FG Polar Relays • Repeating and Retard Coils, several types • 184, 185, 230A and 230B Jack Mountings.

RADIO ENGINEERING PRODUCTS
1080 UNIVERSITY ST., MONTREAL 3, CANADA
TELEPHONE UNiversity 6-6887
CABLES RADENPRO MONTREAL

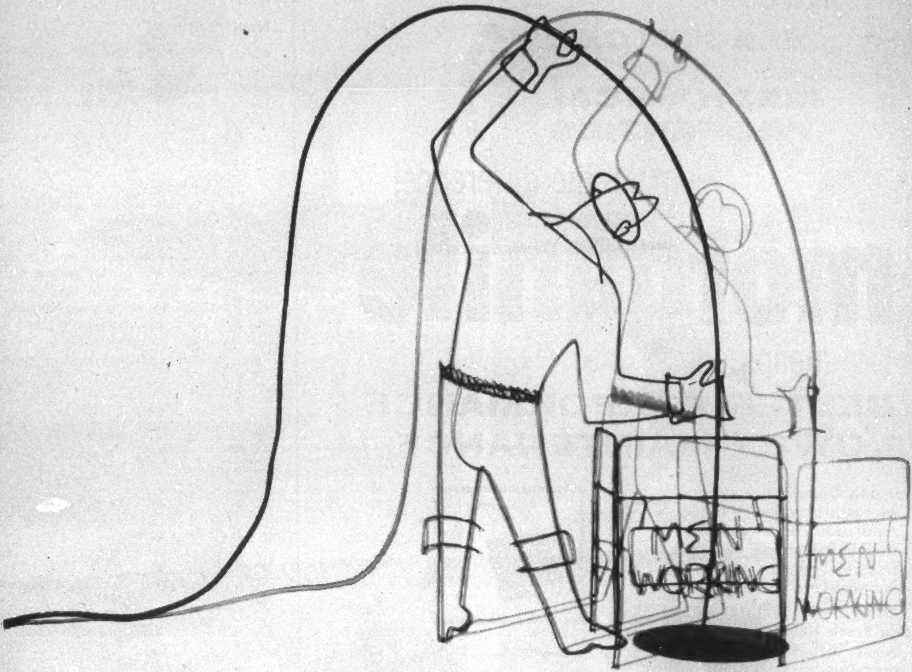
(Continued from page 40A)

New Products

Cylindrical Slide Rule. A cylindrical calculator with great accuracy has been announced. By spiraling the scales around a tube instead of in a straight line, the calculator achieves graduations equal to those of a 66-inch slide rule. Popular with engineers and scientists in England and Canada for a number of years, the cylindrical calculator may be used to solve all problems involving multiplication, division, proportion, percentages, logarithms, roots, and powers. Complete instructions included with each calculator explain the simple three-movement operation. Price, postpaid, of the cylindrical calculator is $19.95. A leather carrying case is also available at $2.50 additional. It may be obtained direct from Arthur F. Smith Co., 311 Alexander St., Rochester, N. Y., or through leading supply houses. *Circle 215 on the card.*

Broadcast and Recording Components. The Studio Dynetic, a one-gram cartridge and tone-arm; the Unitron, a undirectional, Super-Cardioid ribbon element, multi-impedance microphone; and the Commando microphone series have been introduced by Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Ill. The company asserts that the Studio Dynetic is a revolutionary reproducer designed for the most selective high fidelity enthusiasts and for the most critical high fidelity applications in broadcast and recording studios. A great innovation in the Studio Dynetic is that the cartridge employs a magnet moving within a stationary coil. The Unitron (*Model 330*) microphone provides superior performance under adverse acoustic conditions, making it possible for the artist to perform at a distance 92% further from the microphone than is possible with nondirectional microphones. The Commando microphone series is offered in three models

(Continued on page 48A)



Wire sculpture by Henry Szafarz

The Inside Story

Beneath the surface, there's a lot going on. An underground river of power surges through innumerable cables, supplying the electrical energy that keeps the entire community rolling smoothly.

Throughout the nation, Simplex products are used extensively in such applications. This is particularly true of ANHYDREX XX, the ideal all-purpose cable for high-voltage use. This expertly engineered cable is popularly employed in the 2001 to 35,000 volt range, and has a Conductor Temperature Rating of 90°C up to **5 KV** (a rating never attained before the development of ANHYDREX XX).

For more technical data, write for Booklet 1023.

SIMPLEX WIRE & CABLE CO., 79 Sidney Street, Cambridge 39, Mass.

Simplex Anhydrex XX Underground Cable

Simplex

LIVE BETTER ELECTRICALLY

For more information circle 43 on reader service card.

Improved
ELECTRICAL
and
MECHANICAL
PROPERTIES
—make the difference!

morganite
means...
BETTER PERFORMANCE
LOWER MAINTENANCE

Motor and Generator Brushes
Morganite brushes enjoy a reputation world-wide for trouble-free service. Available for fractional horsepower, aircraft, automotive, traction and industrial applications.

Carbon Brush Holders
Assure high efficiency brush operation by maintaining positive contact between the brush and the commutator or ring. Standard types include cantilever radial, radial, trailing, reaction and AC slip ring holders.

Electrical Contacts
Including drum controllers, contactors and starters. Incorporate metals in a refractory carbon base for improved electrical conductivity and mechanical strength. Contacts are self-lubricating, non-welding.

Carbon Current Collectors
Reduce operating costs on travelling cranes. Cost less, wear longer and reduce conductor wear to a minimum. Will not blister or rough conductor, afford trouble-free service over extremely long periods.

Complete Catalogs Available — call or write today. Recommendations on specific applications supplied promptly on request.

Morganite
INCORPORATED . . . FOR OVER HALF A CENTURY
TRADE MARK 3308 48th Avenue, Long Island City 1, New York

Manufacturers of Fine Carbon Graphite Products including Carbon Specialties, Motor and Generator Brushes, Carbon Piles, Current Collectors and Electrical Contacts
Distributors of 99.7% Pure Al_2O_3 Tubes and Crucibles
Circle 44 on the card.

(Continued from page 46A)

New Products

which feature versatility and quality performance at low cost. Suitable both for public address use and for home recording, Commando microphones are of controlled magnetic construction and are unaffected by humidity and temperature variations. *Circle 216 on the card.*

Snap-Slot Wiring Duct. A low-cost plastic wiring duct manufactured by Panduit Company reduces control panel wiring time to an absolute minimum. The duct, which requires no special fasteners, features an exclusive snap-in open slot design which allows wires to be installed in the duct with lugs already attached. The snap-in design completely eliminates the time-consuming operation of threading wire through duct holes. To insert a wire, you simply pull out the plastic finger separating the slots, lay the wire in the duct, and release the finger. A duct cover is snapped in place on the duct after wires are laid. For additional information contact Panduit Company, Dept. EGN 10132 S. Washtenaw Ave., Chicago 43, Ill. *Circle 217 on the card.*

Resistance Thermometer Probe. A truly miniaturized (0.004 inch) high-temperature resistance thermometer probe, capable of operation over a range of 0 to 1,200 C has been produced by Arthur C. Ruge Associates, Inc., Cambridge, Mass. The probe allows measurement of high temperatures, by the resistance thermometer technique, in an extremely small area. Utilizing a grid of extremely fine platinum wire welded to platinum lead wires, the probe is believed to be the first to provide a flat grid temperature element wound on the end of a 1-millimeter tube. Grid is wound on end of double bore porcelain protection tube approximately 0.044 inches at base. All temperature-sensitive wires lie in one plane, giving grid resistance value of from 12 to 16 ohms at room temperature. Probe developed for military use but is available for commercial use. *Circle 218 on the card.*

(Continued on page 62A)

Workman ready to drop tool into concrete. Electric generator is on ground.

See the snarl of cable between tool and generator. Tiger Brand is made for this treatment.

AMERICAN STEEL & WIRE DIVISION, UNITED STATES STEEL, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA., SOUTHERN DISTRIBUTORS
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- asbestos wire and cable
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- shovel & dredge cable
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For more information circle 54 on reader service card.

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OSCILLATOR CONTROLS

CIRCUIT COMPONENTS FOR ELECTRIC OSCILLATORS

MAINTAIN OSCILLATOR OUTPUT FREQUENCY WITHIN CLOSE LIMITS

ALSO USED AS ELECTRO-MECHANICAL BANDPASS FILTERS

FEATURES

- High accuracy
- Stability of frequency control
- Self starting
- Infinite service life
- Integral, sealed, magnetically shielded
- Standard octal tube pin connectors
- Small, light weight

APPLICATIONS

Electrical and Acoustical Measurements
Electrical Communication Systems (Selective Calling)
Remote Operation and Supervisory Control of Machinery and Apparatus
Electrical Computers and Telemetering Systems
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Frahm Oscillator Controls, Type ROC, make possible the design and construction of inexpensive, precision tone generators that are small and light weight. These generators will have accurate output frequency and output voltage with very nearly sinusoidal wave shape.

They can be made with any one nominal control frequency between 20 and 1100 cps. They will control the output frequency of circuits, under specified conditions, constant within ±0.15% of the nominal control frequency.

We particularly encourage your inquiries and correspondence on special applications and problems. If you haven't explored these Frahm Oscillator Controls we'll be glad to send you complete specifications, characteristics, etc. Write for Bulletin 34-EE.

B-706

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LABORATORY & SCIENTIFIC EQUIPMENT
1316 ARCH STREET, PHILADELPHIA 7, PA.

Circle 55 on the card.

(Continued from page 48A)

TRADE LITERATURE

Movie on Lightning. A movie entitled "Let's Look at Lightning!" has been filmed by Line Material Industries (L-M), McGraw-Edison Co., Milwaukee 1, Wis. Highlights include a review of the basic conditions which cause lightning and solutions to various distribution lightning arrester application problems. Important but often overlooked facts and figures on lightning arrester application are illustrated. A showing of the movie can be arranged through the nearest L-M field representative or by writing to the company.

Pocket Battery Buying Guide. "So You're Going to Buy an Industrial Battery" is the title of a 16-page illustrated reference booklet *(GB-1788)* just released by Gould-National Batteries, Inc., Stone and Calhoun Sts., Trenton 7, N. J. Designed to help industrial battery buyers select the most economical and efficient battery for their operation, this pocket size booklet outlines the significance of battery design, and the contributions of research and development to lower operating costs, greater productivity, and greater profits. A condensed description of the company's "Battery Maintenance Schools" is given, as well as information on Gould's plus-performance plan for achieving maximum life and performance from an industrial battery.

Electric Thermostat Bulletin. A folder describing an electric thermostat designed for over-temperature protection is available from Robertshaw-Fulton Controls Company, 110 E. Otterman St., Greensburg, Pa. Model *H1* is intended for use in steam generating systems, coffee urns, ovens, and other commercial, laboratory, and industrial equipment. It automatically will cut-out where the dialed temperature is exceeded by 15F in liquids, or 30F in air. Once it is tripped, the cut-out will remain open until reset manually. The 4-page bulletin provides manufacturers with important information concerning the application and installation of the electric thermostat. Copies of bulletin *RT-805* are available upon request, without obligation, from the manufacturer.

Enamel Wire Bulletin. A 12-page technical bulletin by Driver-Harris Company, 201 Middlesex, Harrison, N. J., gives complete data on the electrical and physical properties of their principal resistance alloys, Karma*, Nichrome*, Nichrome V*, and Advance* (* registered trade marks). Karma enamel-coated resistance wire is now in commercial production in diameters as small as 0.00045 inch, with resistance of 3,951 ohms per foot at 20C. Complete with charts and tables, the bulletin makes it easy for the user to determine exactly which alloy will prove most economical and effective for his specific purpose. A free copy may be obtained by asking for Technical Bulletin No. *157*.

(Continued on page 64A)

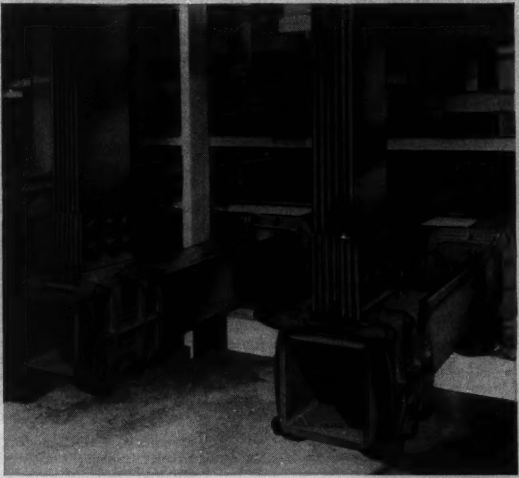
THROUGH THE TINNING LINE, steel sheet up to 38″ wide and .0125″ gage passes at 1000 feet per minute. A total plating current of about 178,000 amps is carried to the 27 collector heads from the bus room below by these rectangular bus conductors. Installation involves about 115,000 lb. of copper bus conductors.

Big new sheet tinning line drawing 178,000 amperes is served by this compact Copper Bus installation

Copper bus conductors were selected for this installation in a plant of one of America's great steel companies because it made possible a saving of 20 per cent in space.

D. Anderson Murphy, president of Riggs Distler & Co., mechanical and electrical contractors, Baltimore, Md., which made the installation, states that one of the big reasons for the selection of Anaconda bus was the outstanding engineering and technical service available through The American Brass Company. Anaconda engineers worked closely with Riggs Distler to help solve many of the problems posed by this complex job. Mr. Murphy adds that the bus conductors came through well packaged, with clean ends indicating a good sawing job, and came through promptly on schedule—other factors in the selection of Anaconda conductors.

TECHNICAL SERVICES. Anaconda specialists are available to help solve technical problems involving the use of Anaconda Bus Conductors. For such assistance or a copy of the 62-page Publication C-25, "Anaconda Copper for Electrical Conductors," write: The American Brass Company, Waterbury 20, Conn.



A VIEW IN THE BUS CONDUCTOR ROOM, showing ventilated square tubes and flat bars. Sizes of tubes used were 6″ and 4″ square by ½″ and 5/16″ by up to 22′ 1″ long. Rectangular busses used 6″ and 4″ x ¼″ in lengths up to 20′.

57102

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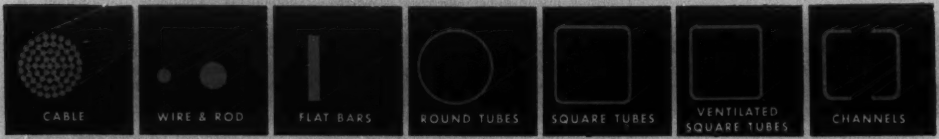

For more information circle 56 on reader service card.

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20 uua or 0.2 uv per division sensitivity

Solve your bridge balance and low-level DC measurement problems with this sensitive, rugged, and versatile combination DC null detector, micro-microammeter, microvoltmeter, and microvolt level DC amplifer.

Current sensitivity of the Model 204A is 20 times greater than high quality, mechanical current galvanometers. As a voltage galvanometer, its extremely high power sensitivity makes it superior to moving coil instruments.

Ideal for production testing, low level DC amplification to extend the range of recording instruments, or as a direct reading indicator for strain gage, thermocouple and other current or voltage measurements in industry or laboratory.

SPECIFICATIONS

- 10uv to 10 volts or 0.001 ua to 1 milliamp full scale in 7 ranges
- All transistorized — Rugged — Insensitive to shock, microphonics, mounting position
- Withstands extreme overloads with no zero offset
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- 10^{-14} full scale power sensitivity
- Use as stable DC amplifier with 1 volt at 1 milliamp output
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Ask for demonstration today or write for detailed literature.

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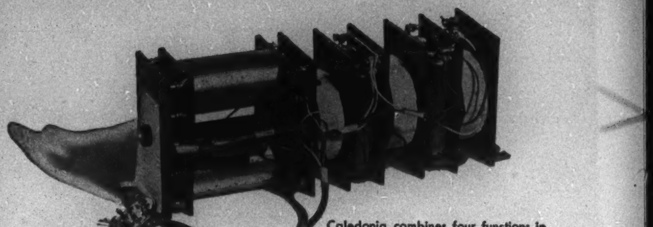
Circle 57 on the card.



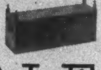
Caledonia combines four functions in miniaturized, shock-resistant package.

Electronics today is partly packaging

PROBLEM: Design a small (50 cubic in.) and light (3¾ lbs.) unit that contains:
1. a positive d.c. pulse selector
2. a negative d.c. pulse selector
3. a high level 60 cps band pass filter
4. a 400 cps detector circuit
(all with tight tolerances, naturally).

Design it to operate within the usual military environmental conditions, including high vibration and shock.

SOLUTION: We assembled the components shishkabob style. Then mounted the kabob in a metal case filled with an epoxy foam compound to hold the parts in a firm cushion.



TIME ELAPSED: From original assignment, through design to volume production—two months.

If such quick, dependable assistance in design and production can make your work more effective, we'll be glad to hear from you. We offer experience, good production facilities, and a recognized quality record.

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Circle 58 on the card.

(*Continued from page 62A*)

Trade Literature

Meter Relay Catalog. Contact meter-relays, versatile instruments that both indicate and control almost any physical or chemical condition that can be detected electrically, are described in a 40-page catalog, No. *4-C*, now available from Assembly Products, Inc. (API), Chesterland, Ohio. The catalog supplies complete information for ordering meter-relays intended for use in original equipment or in self-contained control packages. Various circuits for providing different types of control action are discussed. Also included in the catalog are API panel meters and auxiliary control components.

Antenna System Catalog. A 32-page new product supplement has been published by Andrew Corporation, manufacturers of antennas, antenna systems, and transmission line. This supplement covers products recently developed by the company and information on engineering improvements to their existing antenna systems equipment. Such items as their 9-inch uhf transmission line, 3⅛-inch uhf coaxial switch, and the expanded and improved line of microwave and communication antennas, are completely described in this well-illustrated supplement. Copies of this new product supplement and the existing catalog No. *21*, may be procured by writing Andrew Corporation, 363 E. 75th St., Chicago-19, Ill.

Brochure on Glass for Electronic Use. A brochure, "New Developments in Corning Fotoform Glass," is now available. Fully illustrated, the brochure gives detailed information of the four types of Fotoform glass (Corning Code 8603): how they are made, how they differ, their specific and potential uses, and design and production data on each one. Latest mechanical and electrical applications of Fotoform glass in the electronics and allied industries are reviewed. Corning Glass Works is currently using Fotoform glass in many applications. These range from limited experimental designs to the quantity production of diversified mechanical and electrical components for precise basic assemblies where accuracy, reliability, and long life are essential. The new brochure is available from the company free of charge. Write for brochure No. *EPFF-1* to Staff Sales Manager, Electrical Products Division, Corning Glass Works, Corning, N. Y.

Electronic Component Bulletin. An 8-page bulletin has been issued by Richards Electrocraft, Inc., 3739 N. Kedzie Ave., Chicago, Ill., makers of electronic components. Complete information is given on the company's products including plugs, jacks, connectors, adapters, and pushbotton switches in both standard and miniature sizes. Parts are completly illustrated, drawings show construction details, and tables list sizes and types available.

(*Continued on page 66A*)

DOW CORNING CORPORATION

Silicone Dielectrics

ELECTRICAL AND ELECTRONIC NEWS No. 13

Reliability of Snark Instruments Assured with Silicone Rubber

Engineers at Northrop Aviation take no chances on the performance of intricate high impedance circuits in the "Snark" guided missile, the F-89 Interceptor and other Northrop projects. They virtually "seal in" top performance by completely encapsulating the brains of these units in Silastic* RTV.

A new, easy-to-apply silicone dielectric that vulcanizes into a rubbery solid at room temperatures, Silastic RTV provides positive protection for even the most delicate electronic components. All panels containing resistors, capacitors, transistors and other recording and transmitting gear are embedded in this Dow Corning silicone rubber. According to Northrop engineers, a single coating—

- provides an effective cushion against vibration
- assures maximum moisture resistance
- improves electrical properties, especially surface resistivity
- protects assemblies against rough handling
- may be applied with a caulking gun

Another important advantage of using Silastic RTV in this application is the ease of inspecting or replacing individual components after assembly. The silicone rubber "skin" is simply slit open to expose the component. Such openings are easily patched with more Silastic RTV.

Silastic RTV ranges from a heavy putty to a fluid-like consistency. It attains optimum physical and dielectric properties in 4 to 7 days. ***No. 51***

*T. M. REG. U. S. PAT. OFF.

Westinghouse Introduces Silicone Insulated D-C Motors

While most leading manufacturers of electrical equipment build silicone insulated units for special purposes, now for the first time Westinghouse's new Life Line "H" series offers the advantages of silicone insulation in standard "off the shelf" d-c motors and generators.

Dow Corning silicones have been used in combining a high temperature insulating system with complements of copper and iron equal to those used in conventional Class B machines. As a result, these new motors and generators rated at Class B temperatures have at least 10 times longer insulation life.

In addition, Dow Corning silicones help provide extra protection against emergency overloads and abnormal ambients to reduce motor maintenance. Insulation is no longer a limiting factor to motor life. Already in production, the new dc motors span ratings from 1 to 150 hp: the dc generators are rated from ¾ to 100 kilowatts.

Life Line "H" equipment is designed to be especially useful for automated processing where insulation failure in one unit may shut down an entire assembly line throwing production schedules and costs way out of line.

The extra overload capacity provided by the silicone insulation system makes these motors ideal for conveyor, pump, blower and processing motors in mines; for drive motors in the glass, machine tool, paper and metals industries; for conveyor drive motors in material handling and many other processing industries. ***No. 50***

Silicone Glass Coil Insulators Reduce Small Motor Assembly Costs

By insulating the coils of their ⅛ hp, 14,000 rpm afterburner ignition actuator motors with silicone-glass laminates, Lear, Inc., have cut costs a substantial $1.50 per unit

Located next to jet engines where ambient temperatures soar to 400 F and higher, these motors have always been silicone protected. Lear originally tape-wrapped the coils by hand, but they recently eliminated this time-consuming job by switching to pre-formed glass laminates bonded with a Dow Corning silicone resin.

By reducing assembly time to an absolute minimum, the laminated insulators save Lear $1.50 per motor while still providing the maximum in insulating efficiency. The coil insulators are pre-formed in two sections by Stevens Products of East Orange, New Jersey. ***No. 52***

Send Coupon for More Information

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For more information circle 59 on reader service card.

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Accurate inductance measurement with or without superimposed D.C., for all types of iron core components.

- INDUCTANCE — 1 Millihenry to 1000 Henry
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- CONDUCTANCE — 1 Micromho to 1 MHO
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1210-A Null Detector - V.T.V.M.
1170 D.C. Supply and 1180 A.C. Supply.

FREED
VARIABLE TEST VOLTAGE MEGOHMMETER NO. 1620

The Freed Type 1620 Megohmmeter is a versatile insulation resistance measurement instrument with a continuously variable DC test potential from 50 to 1000 volts.

Components such as transformers, motors, printed circuits, cables and insulation material can be tested at their rated voltage and above, for safety factor.

- Resistance — 0.1 megohms to 4,000,000 megohms.
- Voltage — variable, 50 - 1000 volts.
- Accurate — plus or minus 5% on all ranges.
- Simple — for use by unskilled operators.
- Safe — high voltage relay controlled.
- Self contained — AC operated.

OTHER MEGOHMMETERS AVAILABLE

Type 1620C MEGOHMMETER — a type 1620 with additional circuitry for testing capacitors.
Type 1020B MEGOHMMETER — a 500 volt fixed test potential. Range 1 megohm to 2 million megohms.
Type 2030 PORTABLE MEGOHMMETER — battery operated 500 volt test potential. Range 1 megohm to 10 million megohms.

Send for NEW 48 page transformer catalog. Also ask for complete laboratory test instrument catalog.

FREED TRANSFORMER CO., INC.
1700 WEIRFIELD ST., BROOKLYN (RIDGEWOOD) 27, N.Y.

Circle 60 on the card.

(Continued from page 64A)

Trade Literature

Pocket-Size Slide Chart. A pocket-size slide chart on machining stainless steels is now available from The Carpenter Steel Company, West Bern St., Reading, Pa. This handy chart contains the latest information on how to machine the popular grades of stainless. On one side it gives concise data on turning, drilling, tapping, threading, milling, and reaming operations. It tabulates speeds and feeds, and gives special notes on drilling, tapping, lubrication, and welding. The other side of the chart shows relative workability of stainless steels in a wide variety of operations including blanking, deep drawing, stamping, forging, heading, roll threading, welding, etc. An inserted slide moves to show, at a glance, the machining data desired.

Semipressure Fans. For efficient performance against static pressures normally considered above the range of propeller-type fans, Aerovent *SP-7* semipressure fans, are described and illustrated in Bulletin 400. They are available in direct-connected, direct-driven duct, belt-driven duct, "Bi-Flo" duct, and extended shaft types. For further information contact Aerovent Fan Company, Inc., Piqua 20, Ohio.

Underfloor Electrification. A folder is available describing a new underfloor electrification product called Electro-Channel Steel Joists. This product will be of particular interest to architects, structural engineers, and general contractors. Write to Ceco Steel Products Corporation, 5601 West 26th St., Chicago 50, Ill.

Supervisory and Station Control Cable. The publication of a new as well as complete brochure on supervisory and station control cables has been announced by the Ansonia Wire & Cable Company, 111 Martin St., Ashton, R. I. This illustrated literature introduces the many applications for supervisory and station control cables and gives complete technical information and engineering specifications on the cables offered by the company. It is reported that this publication will provide the most practical and usable data in the field of supervisory and station control cables. Copies are available by writing on company letterhead to the manufacturer.

Bronco Wire Catalog. A 68-page catalog of Bronco Electrical Wires and Cables has been published by Western Insulated Wire Co. and is being offered free to cord and cable users. The catalog contains data on Neoprene and rubber jacketed portable cords and cables, Type *U.S.E.* Style *RR* cables, and asbestos insulated wires. A technical section is included. Write Western Insulated Wire Co., 2425 E. 30th St., Los Angeles 58, Calif.

(Continued on page 72A)

AIEE TRANSACTIONS

Volume 75 of the 1956 Transactions containing all the technical papers approved by the Technical Committees which were presented during the year is now ready for distribution.

The Transactions are a complete record of advancement in the art of electrical engineering during the year.

This volume in three parts, each bound in cloth, size 8½ × 11½, contains 446 papers, 3,028 pages, including discussions. Each part is separately indexed by subject and by authors. Annual subscription prices are as follows:

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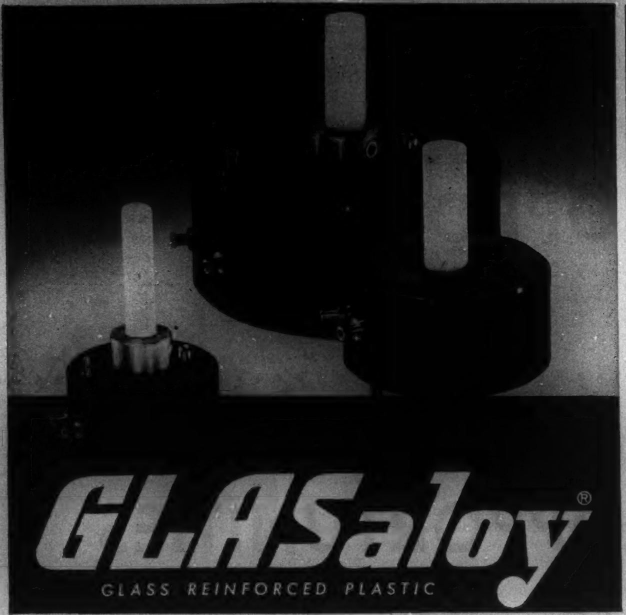

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Typical GLASaloy Shapes

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Gentlemen; I would like more information on GLASaloy.

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COMPANY________________________

ADDRESS________________________

CITY____________STATE____________

For more information circle 66 on reader service card.

(Continued from page 66A)

Trade Literature

Insulated Wires and Cables. Development of a planetary cabling machine for insulated miniature and subminiature cables with individual wires as small as no. 32 American wire gage has been announced by Rockland Insulated Wire & Cable Co., Inc., 36 Main St., Haverstraw, N. Y. The use of planetary equipment eliminates many of the problems associated with the cabling of miniature wire. A costly harness or a number of individual, bulky wires often can be replaced by a special cable, incorporating shielded and unshielded pairs, triples, and other multiples, as well as single conductors. Bulletin 1-57 describing these cables, with samples attached, is available from the company on request.

Hydrocides S-X Colorless Booklet. A 4-page brochure describing the properties and advantages of Hydrocide S-X Colorless, a water repellent coating for masonry, has been issued by the Building Products Division of L. Sonneborn Sons, Inc., 404 Fourth Ave., New York 16, N. Y. The booklet is available by writing directly to the manufacturer.

Industrial Films Booklet. A booklet, "Industrial Motion Pictures," which gives the industrial photographer the information he needs to produce low cost films plus complete data on all 16 mm motion picture films is now available. The 76-page booklet is an optional addition to the recently revised Kodak Industrial Handbook. Although primarily designed to assist the industrial motion picture photographer, the publication also provides the serious amateur motion picture photographer with many answers to problems concerning procedures and materials in film production. Profusely illustrated with how-to-do-it photographs, "Industrial Motion Pictures" is available from Eastman Kodak Company dealers for 50 cents. The complete Kodak Industrial Handbook, or any of its individual booklets may be purchased at Kodak dealers in an attractive binder.

External–Internal Defibrillator. Indicating applicability for closed- and open-chest cardiac resuscitation, a new leaflet describes the Levinthal Morris external–internal defibrillator. The equipment is shown in combined form with the Clinical Pacemaker and the combination is described in the text as instrumentation capable of meeting the full range of cardiac emergencies in the surgery. Included in the leaflet is information on technique, background concerning the development of external defibrillation, features and engineering specifications of the instrument, as well as a bibliography of publications relating to the topic. This literature is identified as Form EID357. Write to: Levinthal Electronic Products, Inc., 751 Stanford Industrial Park, Palo Alto, Calif.

(Continued on page 84A)

Project Engineer Robert J. Cantwell uses a system of gimbals to describe navigational problem in the analysis of a new system design.

Development Engineer J. Robert Holmes computes, with other systems reliability analysts, the operational worth of a bombing system.

You'll find a new challenge DEVELOPING airborne computers at

Staff Engineer William Howard reviews gearing accuracy requirements of test equipment with electronic circuit designers.

IBM

Owego

Circuit Development Group Leader Ralph Wolcott considers future changes in computer output unit for bombing-navigational systems.

The design and development of BRANE (Bombing RAdar Navigation Equipment), now being installed in B-52 aircraft, offer stimulating new challenges to creative engineers at IBM Owego.

Projects currently in process include: Inertial guidance . . . display equipment . . . radar data presentation . . . digital and analog systems . . . transistor circuit packaging . . . test equipment . . . installation.

If you are an electrical or mechanical engineer, a mathematician or a physicist—and want to do development work—you owe it to yourself to investigate the exciting possibilities that airborne computers offer you at IBM Owego.

Development Engineer John Walsh discusses the use of a recording storage tube at IBM's Airborne Computer Laboratories, Owego, N. Y.

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(*Continued from page 72A*)

Trade Literature

Import Requirements Brochure. A handy, quick reference guide to import requirements of 168 foreign nations has been prepared by AEI-Air Express International. With it, a United States exporter can determine specific consular documents, charges, and exact phraseology required for shipments to virtually any spot in the world. The countries are listed in alphabetical order. Each country is keyed by number to indicate the regulations that apply. Free copies of the brochure can be obtained from AEI–Air Express International, 90 Broad St., New York, N. Y. Contact: M. A. Hillias.

Maintenance Booklets. The stories of the films entitled "How To Make a Motor Go . . . and Go, and Go, and Go" and "How to Take Step Seven" are told in bulletins 51X8581 and 51X8582. These films as well as their respective booklets have been put out by Allis-Chalmers Manufacturing Company, Box 512, Milwaukee 1, Wis.

Fiber Glass Reinforced Plastics Materials. A 14-page catalog and price list of materials for fiber glass reinforced plastics includes complete ranges of fiber glass fabrics and fibers, polyester and epoxy resins and catalysts, and other necessary supplies. For further information contact Cadillac Plastic & Chemical Co., 15111 Second Ave., Detroit 3, Mich.

Waveguide Pressure Window Brochure. Waveguide pressure windows and their uses are described in a brochure prepared by Microwave Associates, Inc., Burlington, Mass. The electronics firm explains that waveguide pressure windows freely propagate r-f energy over a restricted bandwidth of frequencies and seal off sections of waveguide in radar or other microwave waveguide applications where pressure or humidity and dust seals are required. Performance curves, outline dimensions and drawings, and complete electrical and mechanical data are given in the brochure for each window type. Helpful installation instructions are also included. For a copy of this brochure write to the company.

Check List. To locate the hidden probabilities of electrically ignited explosions in plants, a hazard finder is being made available by Crouse Hinds Company. This 8-page, illustrated folder contains a check list of 13 questions that can help determine whether uncontrolled flammable gases, vapors, dusts, liquids, and other combustible materials are making a plant unsafe. Part of the folder is sealed until all the questions have been answered. After the seal is broken, an evaluation of the hazard potential in the plant is revealed, based on the answers of the reader and the findings of the National Fire Protection Association. For a free copy, write on company letterhead to Hazard Finder, Dept. HF, Crouse Hinds Company, Wolf & 7th No. Sts., Syracuse, N. Y.

THERMAL EVALUATION OF INSULATING MATERIALS

(June 1954)

At the 1954 Winter General Meeting the Subcommittee on Dielectrics and its Working Group sponsored three sessions of papers covering various phases of the problem of evaluating insulating materials. Since these papers review much of the recently developed information on this subject, it was decided to reprint them in this form. As test methods on the thermal evaluation of insulating materials become available, more and more data on thermal stability of both the newer and the older materials should develop, and eventually make possible the rational revision of AIEE Standard Number 1 on a sound basis.

The 72-page printed publication contains 16 papers and discussions, presented at the 1954 AIEE Winter General Meeting.

Publication S-61 is available at the price of $1.50 to members and nonmembers. Send orders to:

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